THE UNIVERSITY
of EDINBURGH

Peer Learning in the Clinical Setting

Dr Neill Storrar

MD in Clinical Education – The University of Edinburgh – 2019

Contents

List of Figures

List of Tables

Declaration

This thesis is my own work. Under the supervision of Professor Helen Cameron and Dr David Hope, I chose the research area, conceived the major strands of the research, undertook the data collection and analysis, and wrote the manuscript. My supervisors provided critical discussion and contributed to the revision of the manuscript. Other acknowledgements are given below and in the text.

This work has not been submitted for any other degree or professional qualification.

Signature

Dr Neill Storrar, 11th May 2019

Acknowledgements

I could not have written this thesis without the help of many people. Professor Helen Cameron deserves enormous credit as my principal supervisor and colleague. Her mentorship, wisdom and enthusiasm, coupled with diligence and critical thinking have made all of this possible. Dr David Hope has been equally brilliant – calm and encouraging, insightful and open minded. Thank you for your timely and constructive feedback; exemplary.

Dr Fiona Scott and Dr Peter Johnson were both gracious with their guidance and assistance with undertaking the Clinical Fellowship and the MD.

Many other people were generous with their time and insights. Dr Derek Jones and Dr Tim Fawns both lent me their friendship and critical faculties at various stages. Derek also put me in touch with Dr Jenna Breckenridge whose expertise and generous guidance on (Classic) Grounded Theory was inspirational. Avril Dewar gave excellent technical, programming and supportive advice. The CME, MSc and Clinical Skills teams provided general welfare, tea, and cake, received with much thanks.

The Peer Practice project itself was only possible because of the work of others. Drs Karen Fairhurst and Martin Denvir deserve particular praise, as do Gavin Brown and Jamie Nicholson. David Kluth, Alan Jaap, James Tiernan, Charlie Lees, Maria Eugenicos, John Plevris, Peter Hayes, Mike Williams, Hugh Paterson all gave up time to contribute to the project and revise the Common Criteria. Lydia Crow and Stephannie Hay were brilliant with Pebble Pad. Medical students Sara Moin, Lin Tan and Rory Thompson very kindly helped me refine the work, and Tom Erlandsen on the FYC was great.

Thanks also to the staff and students of the Medical School, NHS Lothian, NHS Fife and University of Edinburgh for their participation.

In the other MD/PhD students I found friendship as well as intelligent (and irreverent) help with the sometimes arduous journey. Laila, Nok, Claire,

Siobhan, Effie, Gemma, Scott and Michelle were and are great. Katy and Shaun were there from the beginning and know how brilliant it has been to form a true Fellowship.

And Kirsty and Hamish – simply wonderful. Strength and wonder in all the ways that matter, my happiness and my gratitude.

Abstract

Qualified doctors must work and learn together. Peer learning - where students at a similar level teach one another - seems well suited to achieving these complementary goals of competence and collaboration. Peer learning is widely practised in medical education particularly in the classroom and skills laboratory, but there is less evidence for its use in the setting of wards and clinics where much of medical training takes place. While studies do report peer learning in the clinical arena, there remain unanswered questions about its measurable impact on performance – is peer learning effective in the clinical setting? There is also a gap in the understanding of its impact on peer relations. Critically, while many advocates of peer learning have emphasised its social benefits, others have highlighted risks to students for example through development of unhealthy competition. This leads many students to be unwilling to engage in peer learning at all. These conflicts are not well covered in current theoretical models of peer learning in medical education.

We therefore do not have a clear understanding of the practical benefits of peer learning in the clinical setting, or how students respond to the potential conflicts involved in peer interaction. This thesis tests whether peer learning in the clinical setting leads to gains in ability, and explores the contradictory pressures that govern student decision making about peer learning. It is structured as follows.

In Chapter One the concept peer learning is introduced and its role in the clinical setting is briefly surveyed. The theoretical framework of the thesis – Pragmatism – is defended, and is followed by a discussion on methodology.

In Chapter Two a published paper is presented based on students' general priorities in medical education. This confirms the plausibility of peer learning in the clinical setting, and demonstrates the author's development of key research skills.

In Chapter Three the way students resolve potential conflicts in peer learning is explored. Using Classic Grounded Theory – an established method of theory generation – the novel theory of 'Internal Negotiation' is explained. The theory predicts how students will balance educational and social pressures when making decisions about engagement with peer learning. This is followed by a discussion of the theory's place in the wider literature and its practical implications for those interested in improving peer learning projects.

Chapter Four presents the results of project testing the impact of a peer learning project in the clinical setting. The project – dubbed Peer Practice – was intended to promote abilities in basic consultation skills. The literature review highlighted a major gap in the evidence for peer learning's impact on performance in the clinical setting. The effect of Peer Practice was tested through the lens of the 'practical trial' using experimental cross-over type design to answer questions about performance gain, impact on students' view of peer learning, peer learning's acceptability and other measures. A small performance benefit from Peer Practice was demonstrated, and the consequences for future work are discussed.

Chapter Five integrates the lessons of the preceding chapters. In summary the thesis has developed a new and plausible theory of peer learning and how students negotiate social and educational tensions when choosing whether to take part; it has presented a rigorously designed experimental study of peer learning in the clinical setting and demonstrated modest performance gains amongst other benefits. It has thus added to the knowledge of peer learning in medical education and drawn lessons for those interested in promoting clinical competence through the use of collaborative activities in the clinical setting.

Word Count (including the published paper but excluding abstract, lay summary, bibliographies and appendices): 59 996

Lay Summary

Good doctors learn together. To help prepare doctors for this challenge, many medical schools use 'peer learning' where students teach other students; they learn to teach at the same time as learning medicine. The benefits compared to traditional approaches include education in a more informal atmosphere, and learning from people with an intuitive insight into baseline ability. On the other hand, medical students are often highly competitive, and can find comparisons with other students to be a source of stress. Studies of peer learning also find that some students are reluctant to take part, or to give one another honest feedback.

This seems contradictory – peer learning is supposed to be supportive, but is also a source of stress. A better understanding of how students deal with this contradiction would help us reap the benefits of peer learning without too many drawbacks.

Another unresolved issue is that most examples of peer learning in medicine have taken place in the classroom. However, much of medical training takes places in the workplace: in hospitals and general practice. There is less experience with students learning medical skills in this 'clinical setting,' and there is little evidence testing whether peer learning has advantages over traditional learning there.

This thesis addresses both of these issues. Regarding the contradictions in peer learning, it develops a theory of how students continuously balance educational and social pressures. This theory is dubbed 'Internal Negotiation'. Briefly, they are more likely to engage in peer learning when they see it as intrinsically useful (it has 'Expected Educational Gain') or when it helps them build relations with other students ('Social Reward'). On the other hand, they are less likely to take part when they find the experience potentially embarrassing or threatens their reputation ('Social Risk'). This theory suggests ways to improve peer learning, for example by trying to reduce the Social Risk of participation or increase the Social Reward.

Regarding the evidence for peer learning in the clinical setting, a teaching project called Peer Practice was tested in the hospital using an experimental design. Some students learned basic clinical skills in the normal way, and others learned them through an enhanced peer learning programme. Those who used peer learning did slightly better in end of year assessment than those who did not. They also viewed peer learning more positively and reviewed Peer Practice favourably, suggesting the benefits outweigh the risks.

In summary, this thesis looked at peer learning in the clinical setting. It developed a new way to think about how students balance contradictory pressures when choosing to take part, and tested peer learning in the medical workplace with positive results. It therefore adds to the theoretical and practical understanding of peer learning, and findings may be helpful to those interested in peer learning in other workplace settings.

Chapter 1 Introduction

1.1 Peer Learning in the Clinical Setting

Competent doctors teach each other. This principle is established in the UK General Medical Council's guidance on the abilities new graduates must have. A competent doctor must be able to '*function effectively as a mentor and teacher including contributing to the appraisal, assessment and review of colleagues, giving effective feedback, and taking advantage of opportunities to develop these skills'* (General Medical Council 2015, pp. 9, paragraph 21 f). A promising way to help graduates attain this is use 'peer assisted learning', defined by Topping as 'people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by teaching' (Topping 1996, p. 322). There are multiple approaches such as peer tutoring where one student acts as a principal teacher for others, and peer assessment where students evaluate the quality of others' work and learn by doing so (Topping 2009). For simplicity this thesis will use the term 'peer learning' to encompass all of these. In an ideal model medical students would teach one another and gain the clinical abilities the GMC demands (such as how to assess a patient) *and* the teaching abilities outlined above. Both of these goals are important. Studies continue to report deficiencies in the preparedness of new doctors in areas from prescribing to clinical communication (Monrouxe *et al.* 2017). Worryingly, new graduates over-estimated their abilities in 11 of 13 domains when compared to their supervisors' ratings of those abilities (Tallentire *et al.* 2011). This included acute care and prescribing but also basic history taking and examination.

This is something that peer learning could help with: literature highlights many benefits for students including improved clinical skills (Tai, Molloy, *et al.* 2016, Tolsgaard *et al.* 2016, Herrmann-Werner *et al.* 2017), better understanding of the standards expected (Ten Cate and Durning 2007a, Tai, Molloy, *et al.* 2016), as well as development of skills in teaching itself (Burgess *et al.* 2014a). This stems from the theoretical advantages of being taught by someone at a similar level – they may have a better understanding of your current knowledge and how to improve it than a more senior,

educationally distant tutor (Ten Cate and Durning 2007b). Students are considered more socially supportive and less intimidating than senior tutors (Ten Cate and Durning 2007b, Lockspeiser *et al.* 2008) and are available to give one another feedback immediately and repeatedly (Falchikov and Goldfinch 2000, Topping 2009)

Peer learning seems like an ideal tool for the task of improving preparedness of clinicians for the challenges of medicine. In fact it is well established in both formal and informal aspects of medical education. Popular classroom approaches like problem based learning (Walton and Matthews 1989, Poulton *et al.* 2014) and team based learning (Parmelee *et al.* 2012) depend heavily on peer to peer teaching and are widely used (Pluta *et al.* 2013). Recent reviews have also documented its use for teaching clinical skills, building clinical judgement, improving students' collegiality and indeed building teaching skills (Burgess *et al.* 2014a, Tai, Molloy, *et al.* 2016, Tolsgaard *et al.* 2016).

1.1.1 Conflicts in peer learning

There are drawbacks. In one report, around half of students in the clinical setting considered it inappropriate to give one another feedback on performance (Bennett *et al.* 2012). A survey of medical students' views of peer learning found a quarter agreed or strongly agreed that peer learning could encourage 'unhealthy competition' (Tai *et al.* 2014). Studies of student welfare report that comparisons with peers' performance is a source of stress (Radcliffe and Lester 2003, Lempp and Seale 2004). When students are asked to give each other feedback on professional behaviours in peer assessment students express significant concern that they will be harming friendships with other students (Arnold *et al.* 2005) and nearly a third of students do not feel comfortable assessing other students' professionalism (Kovach *et al.* 2009). This is not to say that peer learning is necessarily *harmful*, but on the one hand we read that students are supportive and 'socially congruent' (Ten Cate and Durning 2007b, Lockspeiser *et al.* 2008) and on the other hand studies report the experience of performing in front of

other students to provoke significant social anxiety (Laidlaw 2009). These contradictions must be addressed if we are to use peer learning in a responsible way.

1.1.2 Evidence: same-level peer learning in the clinical setting

It is incumbent on educators to implement learning that is useful, if for no other reason that we must be able to justify to students, faculty and funding bodies that our efforts are efficient and cost-effective (Cook 2012, Tolsgaard, Tabor, *et al.* 2015). We must ask what the evidence is for the approach we wish to use. This thesis will focus on students at the same level learning basic clinical skills in the clinical setting, justified as follows.

1.1.2.1 Same level peer learning

While peer learning has often included 'near peers' (Burgess *et al.* 2014a), the use of 'same level' peers is more in keeping with Topping's original definition (Topping 1996, Olaussen *et al.* 2016). Students at the same level presumably have all the advantages of social congruence etc. highlighted by the theorists (Ten Cate and Durning 2007b) as well as practical advantages of shared timetabling, upcoming assessment milestones and similar baselines on which to design training (Tai, Molloy, *et al.* 2016).

1.1.2.2 Clinical Skills

This thesis will study basic clinical skills such as history taking and physical examination because they are a fundamental part of modern medical practice (General Medical Council 2015), and are an area where graduate competence is known to be suboptimal (Hastings *et al.* 2006, Tallentire *et al.* 2012). It is also an area where peer learning is already practised (Duvivier *et al.* 2012, Tai *et al.* 2014, Young *et al.* 2014); it is therefore a reasonable subject for exploring the sorts of conflicts discussed in the preceding section. This also suggests that any new peer learning initiatives based on learning clinical skills would be viable in practice.

1.1.2.3 The Clinical Setting

The workplace setting of wards, operating theatres, clinics and community practice (hereafter 'the clinical setting') is a major arena of study for medical students, particularly as they approach graduation (General Medical Council 2009). It is a complex environment that presents challenges to students including integration with the clinical team, contributing to rather than interfering with clinical work, and learning the professional behaviours expected in the workplace (van der Zwet *et al.* 2011). It is not obvious that peer learning will help with these challenges; some work has already highlighted barriers to the use of peer learning in the clinical setting particularly if it distracts from students' desire to learn from experts (Bennett *et al.* 2015).

1.1.2.4 Current Evidence

One review of peer learning of clinical skills found good evidence of benefit over individual learning when training took place in the clinical skills laboratory or class room (Tolsgaard *et al.* 2016). But this review also concluded that there was little current evidence that this would hold in the clinical setting, perhaps because of the social and practical complexities highlighted above (van der Zwet *et al.* 2011). A systematic review of the role of same level peers on clinical placement found that although there were several studies about clinical skills, study quality was often poor, used student self-report as an outcome, or only evaluated student reactions without a higher level measure of performance such as effect on clinical outcomes (Tai, Molloy, *et al.* 2016). Moreover, many of the studies cited in this review actually take place in skills laboratories or classrooms (though the students were in 'clinical years' of their degrees). The evidence base for the role of peer learning which *actually takes place in the workplace* does not appear strong; this evidence will be formally reviewed in Chapters 3 and 4 of this thesis.

1.2 Research Aims

To summarise, peer learning promises much for the development of graduates' roles as clinicians and teachers, but there are potential conflicts related to student competitiveness and the stresses of comparison with other students. Learning from other students may not be a high priority in the workplace. This could limit engagement with and participation in peer learning. Furthermore, there is a need for more study into the tangible benefits with peer learning of clinical skills that takes place in the clinical setting. This thesis therefore has three main aims.

1) Characterise students' main priorities in the clinical setting with a view to testing the plausibility of expanding the role of peer learning there
2) Identify the way that students navigate potential conflicts in peer learning when making decisions about whether to take part
3) Evaluate the benefits to students of taking part in same level peer learning of clinical skills in the clinical setting

The thesis is structured around these aims; Chapter 2 presents a published paper that asked students about their overall priorities in clinical medicine; Chapter 3 presents a theory of student decision making in peer learning to gauge how they navigate the conflicts outlined above; Chapter 4 presents the results of a trial of peer learning of clinical skills in the clinical setting. The next section describes the theoretical underpinnings of the research presented in these chapters to justify the decisions made about research methodology.

1.3 Theoretical Issues

In this section I discuss the theoretical framework for this thesis. I will discuss the requirement for a firm theoretical foundation, typical approaches, and the decision to adopt the insights of pragmatism for this thesis. I will demonstrate a critical engagement with the concepts described and defend the methodological decisions made.

1.3.1 Choosing a theoretical framework

A standard approach in social research is to set out your philosophical worldview before making other decisions such as your research methodology:

> No inquirer, we maintain, ought to go about the business of inquiry without being clear about just what paradigm informs and guides his or her approach. (Guba and Lincoln 1994) p116

Guba and Lincoln lay out four main paradigms – sets of basic beliefs – each of which has attendant implications for choosing research methodologies and methods. Paradigms are distinguished from one another by the assumptions they make based on the researcher's *ontology* (study of how things are) and *epistemology* (study of what we can know). These are summarised in Table 1-A adapted from (Guba and Lincoln 1994).

Table 1-A: Four Paradigms for Social Research - Adapted from Guba and Lincoln 1994

	Ontology	Epistemology	Implications for research
Positivism	Naïve Realism – there is a real world and everything in it is governed by clearly identifiable laws	Objectivism – we can know the world as it is: investigators are distinct from the objects of inquiry.	Methodology implies testing of hypotheses to arrive at accurate representation – typically through experimental designs
Post-positivism	Critical Realism – there is a real world but our ability to apprehend it is limited by the nature of human experience	'modified' objectivism – we can never be certain of reality but arrive at closer approximations through research and critical review of data	Testing hypotheses within the limits of our ability to apprehend reality. Experiment results in imperfect but increasingly accurate representations of reality
Critical theory and related approaches	Historical Realism – there is no 'real' world we can apprehend, but the history of societies has created structures that are taken as real.	'Transactional Subjectivist' – societies create structures and traditions which individuals take to be real. Distinction between ontology and epistemology blurred.	Focus on dialogue between researcher and participants - how socially created structures can be challenged, often with a view to liberating oppressed groups
Constructivism	Relativism – there is no 'real world' with all meaning and belief mediated through shifting conventions of language and symbol	Subjectivist – knowledge is continually created and interpreted, with no real/objective truths possible. Distinction between ontology and epistemology blurred.	Reconstruct a worldview created by participants and researcher together. Focus on qualitative data with non-generalisable conclusions

This approach has widespread acceptance in the medical educational literature, with the importance of paradigm being stressed in multiple guides to research (Lingard 2007, Bunniss and Kelly 2010, Watling and Lingard 2012, Illing 2014). It is recommended that researchers in social sciences – including medical education – consider 'what they believe' about the nature of reality and knowledge (Guba and Lincoln 1994, Biesta 2010) and use this as the basis for determining how they approach academic studies. For example, a post-positivist would tend to use quantitative data and might be interested in studying psychometrics; a constructivist might use qualitative data generated from interviews and give an account of learners' perspectives that incorporates the researcher's own perspective – the co-creation of knowledge (Bunniss and Kelly 2010). These paradigms are considered mutually exclusive: a constructivist focus on joint researcher-participant creation of context-specific knowledge would not seem to fit easily with a post-positivist discussion of generalizable abilities like clinical competence 'stripped' of context (Illing 2014). This relates to a philosophical debate about 'paradigm wars' where the claims of realist post-positivists and relativist constructivists are seen as part of an 'incompatibility thesis' (Howe 1992). Such incompatibility is endorsed by Guba and Lincoln

> The basic beliefs of the paradigms are believed to be essentially contradictory…constructivism and positivism/post-positivism cannot be logically accommodated anymore than, say, the ideas of flat versus round earth can be logically accommodated (Guba and Lincoln 1994), p116

1.3.2 Problems with this approach

This approach is contested (Creswell 2010). The features of the four paradigms are not universally agreed (a point acknowledged by Guba and Lincoln in a footnote). For example, Guba and Lincoln argue that one's epistemology and ontology are strongly linked in the pairings outlined in Table 1-A e.g. their description of post-positivism pairs (critical) realist ontology and 'modified *objectivist'* epistemology, the 'assumption that it is possible to approximate (but never fully know) reality' (Guba and Lincoln

1994, p.111). Others disagree: in an exposition of the philosopher Roy Bhaskar's description of critical realism Johnson and Duberley describe Bhaskar's view that we can instead pair realist ontology with *relativist* epistemology (Johnson and Duberley 2011): while all knowledge is socially constructed and interpreted, this does not preclude there being a real world. This position is taken as being somewhere between a positivist and constructivist view of knowledge. This is significant because Lincoln and Guba claim that post-positivism is linked with experimentation and falsification studies (see Table 1-A) which does not fit well with relativism. At the very least the definitions of the four paradigms outlined by Lincoln and Guba are contentious.

Moreover, many researchers have argued that these philosophical issues do not need to be resolved at all – one can instead mix approaches associated with quantitative or qualitative traditions. The developing field of Mixed Methods Research, MMR, epitomises this. MMR has been defined as

> where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study (Johnson and Onwuegbuzie 2004)

This approach has advocates in clinical educational research like Creswell who outlines various decisions that could be made – such as whether the 'quantitative' or 'qualitative' part of the study takes precedent (Creswell *et al.* 2004). These researchers have often invoked the concept of pragmatism to justify these decisions (Biesta 2010). I will therefore explore pragmatism and its relevance to this thesis.

1.3.3 Pragmatism

There is an everyday use of pragmatism – the right tool for the job. Here researchers make common sense decisions based on practical considerations such what the best data collection method would be for a given question (Biesta 2010). A deeper *philosophical* pragmatism requires fuller explanation.

Philosophical pragmatism was developed in by American philosophers such as Dewey and Peirce in the early 20th century as a riposte to the realism vs relativism paradigm debates (Morgan 2014). They argued that what was most important to philosophy was not the resolution of this debate, but a refocus on an interplay between belief and action (Morgan 2014). The contemporary philosopher Richard Bernstein outlined some key components of the pragmatic tradition (Bernstein 1991):

- *antifoundationalism* where the possibility of a permanent underlying structure for all philosophy (as in positivism) is rejected;
- *fallibilism* where it is taken that while we must begin any discussion with certain prejudgments, 'there is no belief or thesis – no matter how fundamental – that is not open to further interpretation and criticism.'
- *community of practitioners* – the contingent nature of these beliefs prompts us not to put too much stock in our own perspectives but always seek views and discussion with other enquirers to better understand the arguments;
- *radical contingency* – so much in the universe appears random and unexpected that the aim of 'mastering' future events is futile
- *pluralism* – there is thus no escape from a multitude of traditions, positions, interpretations and orientations.

These features are then tied to questions about the practical purposes of research. Tashakorrie and Teddlie argue that pragmatism allows one to reject a rigid choice between realism and relativism, i.e. rejecting the incompatibility thesis. The more important feature becomes the research question, which then sets the tone for judging quality and value of the work:

> study what interests and is of value to you, study it in the different ways that you deem appropriate, and utilize the results in ways that can bring about positive consequences within your value system (Tashakkori and Teddlie 1998, p.30)

In other words, since there is no foundation on which to build all our approaches, what matters most is not our abstract commitment to one philosophical position, but the implications of choosing one research procedure over another. That depends on what we value i.e. outcomes. As Morgan puts it, 'what is the impact of making one set of choices, rather than another?'(2014, p. 1051).

The emphasis on justifying decisions about procedure based on outcome puts a burden on researchers to explain their decisions. The research quality criteria therefore depend on the choice of research question and the appropriateness of procedures used to address these questions (Morgan 2014). These decisions are thus described for this thesis as a whole, and for each chapter. Common practice is to judge each component of multi-methodology research according to the criteria associated with each component (Bryman *et al.* 2008, O'Cathain 2010): this approach is taken here.

1.3.3.1 Overall context

The goal of this thesis is to understand the role of peer assisted learning in the achievement of clinical competence. This has several aspects: how peer learning fits into students' overall goals, understanding potential conflicts in student participation in peer learning; the effects of peer learning on clinical ability. This multifaceted approach implies multiple approaches would be appropriate, in keeping with a pragmatic perspective. The decision to use different approaches in one study – constructivist thematic analysis, classic grounded theory, practical trial methodology – is therefore consistent with established practice in mixed methods research (Creswell 2010) and medical educational research more generally (Illing 2014).

The requirement to explain one's value system (Tashakkori and Teddlie 1998) is taken to include a description of the broad setting of the work. The context here is UK medical training; typically a 5-6 year undergraduate course followed by competitive application to a two year 'foundation programme' of general postgraduate training, then 3-8 years of clinical

specialisation (British Medical Association 2018). The aims of this training are set by the UK regulatory body, the General Medical Council, GMC, through documents like Outcomes for Graduates (General Medical Council 2015) and Promoting Excellence (General Medical Council 2016). It is from this framework that the focus on both clinical competence and teaching colleagues are derived. I am a practising clinician trained in this system and professionally invested in the practice of medicine to promote patient care. Additionally I am an educator in the medical school under study with obligations to improve and promote good educational practice.

All of this means that the success of this study is considered in light of its relevance to promoting clinical competence and patient care in the terms of reference set in modern UK medical practice. I will now defend the research approach taken for each of the main thesis aims.

1.3.3.2 Understanding student priorities

Chapter 2 presents a published paper that looked at students' accounts of their overall priorities. The emphasis was on understanding what matters most to students in education overall, with a view to establishing some context for the rest of the study and developing my research skills. General questions included: How feasible is peer learning in this institution? How might it fit into students' other goals? The outcome was open in that it depended on student views, and therefore a more constructivist perspective was taken. I used constructivist thematic analysis to link student views. This implies researchers must be cautious in generalising from the result, and must account for their own positions in the development of the findings (Braun and Clarke 2006).

Alternative approaches could have included some method of presenting students with frameworks of hypothetical priorities for students to appraise, perhaps via surveys. The paucity of published research in the area makes pre-population of such a survey difficult, and would have made it more difficult for surprising priorities to be presented by students.

1.3.3.3 Understanding conflicts in peer learning

The purpose of Chapter 3 is to develop an understanding of students' concerns in relation to peer learning of clinical skills in the clinical setting, particularly given the potential conflicts highlighted in the introduction. Grounded theory is a method suited to this, seeking as it does to understand social behaviours and develop models to explain them (Watling and Lingard 2012). The role of theoretical frameworks in grounded theory is highly controversial and no consensus exists on which is the optimal approach (Watling and Lingard 2012). The rationale for choosing Glaser's Classic Grounded Theory, CGT, over others forms will be discussed in detail in the chapter itself, but CGT appears consonant with a pragmatic outlook. CGT quality criteria place strong emphasis on the product; CGT purports to defy any commitment to any one ontological/epistemological tradition; CGT explicitly embraces the integration of quantitative and qualitative data, rather than committing to one or the other (Glaser and Strauss 1967).

Alternative approaches to understanding the way students navigate conflicts in peer learning could have included ethnography (Tai, Canny, *et al.* 2016a) or activity-systems theory (Bennett *et al.* 2015), but such studies already exist; a grounded theory in this field does not. Further, the testing of concepts such as competition in the field could have been done using psychometric instruments, but this would prejudge the overall concern of the participants, and thus not address the research question.

1.3.3.4 A note on data collection for Chapters 2 and 3

The same 16 interviews with medical students provided data for both Chapters 2 and 3. This is reflects the way that data can be interpreted differently depending on the research aims (consistent with pragmatism). In Chapter 2 responses to questions about overall motivation and goals priorities were thematically analysed to characterise students' educational objectives. In Chapter 3, transcripts (and other data) were analysed using Grounded Theory to develop a model that explains students' behaviour in peer learning. Note that this dual-intention for interviews and data collection

is explicit in the ethical application in Appendix 1. Implications for quality standards, research concepts such as 'data saturation' etc are discussed in the methodology and conclusions of each chapter.

1.3.3.5 Testing the Effectiveness of Peer Learning

In Chapter 4 the question is about the effectiveness of peer learning in the clinical setting. It evaluates a teaching project called Peer Practice and draws on the notion of practical trials which are

> carried out in real-life settings and are characterised by (i) comparison of viable alternative education strategies, (ii) broad inclusion criteria regarding participants across several settings and (iii) multiple outcome measures with long-term follow-up to evaluate both benefits and risks (Tolsgaard *et al.* 2017)

Such *prima facie* practicality chimes well with pragmatism's focus on outcomes, and the use of experimental methodology seems entirely appropriate given that one motivation for using peer learning is to promote competence in the terms that regulatory bodies value: summative assessment, demonstrable ability to work with peers; resource-effective teaching.

Alternatively, a constructivist framing might include consideration of the lived experience of students taking part in the peer learning used, as in phenomenology, but such a study would not explicitly seek to give recommendations for practice (Ng *et al.* 2013) and so not fit the question asked. A study to measure peer learning's impact on another aspect of education – such as the student's motivation or 'self-determination' (Kusurkar *et al.* 2011) - would have been valuable, but would not have addressed the question about benefitting clinical performance or other practical considerations..

1.3.4 Personal Perspective

My own view is that the requirement for me to choose what I 'believe' about the nature of ontology and epistemology is not satisfactory. Each tradition appears to have value, and the notion that I should declare my 'allegiances' (Watling and Lingard 2012, p. 857) seems to invoke undesirable notions of tribalism and confrontational debate. While such polemicism is doubtless appropriate at times, a less argumentative approach has benefits. The philosopher Richard Sennett compares the *dialectical* approach - vigorous opposing arguments aimed at winning discussions and reaching consensus – with the *dialogical* approach where enquirers abstain from taking firm positions but explore the issue in a non-confrontational way (Sennett 2012). He suggests that dialogical inquiry is more conducive to mutual understanding between groups; this seems laudable to me. This finds echoes in the writings of the pragmatist Richard Bernstein who advocates for 'engaged fallibilistic pluralism' where people of different traditions participate in serious open minded debate (engaged), are committed to the idea that their view is subject to change (fallibilistic) and that multiple approaches have merit (pluralism) (Bernstein 1991, p. 336). This also squares well with the practice of medicine where clinicians use working diagnoses but are always willing to reframe problems based on new information. As a clinician I take different perspectives depending on the issue at hand. An apparently realist perspective is useful when choosing the chemotherapy regimen most likely to cure patients with leukaemia, but I would take a much more 'relativist' approach when discussing the appropriateness of chemotherapy for patient with multiple medical, personal and social concerns at stake. Montgomery has argued that such flexible, practical reason (related to the Aristotelean concept of *Phronesis)* is a characteristic feature of medical thinking (Montgomery 2006), and the resonance here with a pragmatic research approach is striking. If this amounts to a declaration that I 'believe' in pragmatism, it is a rather non-committal belief.

1.3.5 Summary of Theoretical Issues

I have critiqued the traditional requirement to declare an ontological and epistemological position when undertaking educational research. I have evaluated pragmatism as an alternative approach where such issues are subordinate to the purpose of the research, and outlined how consequent methodological decisions were made for each chapter. I will now summarise the thesis order to orient the reader through the remainder of the work.

1.4 Thesis Overview and Research Questions

This thesis will explore and address peer learning in the clinical setting using a pragmatist framework. It comprises three substantive chapters that address each of the aims highlighted above. The justification for each research question is in the appropriate chapter, but for clarity these are presented here.

Chapter 2 presents a published paper exploring students' overall priorities in medical education. The chapter discusses the plausibility of using peer learning in the clinical setting, and also documents the development of some of my own research skills. Its question is:

- What are medical students' main educational priorities?
- Chapter 3 presents a Classic Grounded Theory of what guides student decision making the peer learning. It creates a model that predicts how students will balance competing educational and social tensions when choosing whether and how to engage in peer learning. In contrast to many existing theories about peer learning it integrates the factors that limit or compromise peer learning. This has the advantage of providing educators with lessons about what they should do to optimise peer learning projects.*What is the main concern of medical students in relation to peer learning in the clinical context?*

Chapter 4 presents the results of such a project – Peer Practice - that was introduced to the clinical setting. The literature review identifies a significant gap where no published studies have tested the effect on performance of peer learning that takes place in the clinical setting. Peer Practice was a package of incentives and opportunities for students to practise basic clinical skills with their peers in the clinical setting. The effects of this project were studied through the lens of practical trials, with outcomes including performance gains, impact on attitudes to peer learning and practical acceptability amongst other concerns.

Its research questions are:

1) Does reciprocal peer learning of consultation skills in the clinical context promote competence?

2) a) How does experience of peer learning affect attitudes to peer learning in general?

2b) How does experience of peer learning affect peer learning behaviours?

3) Is peer learning acceptable to students in clinical settings?

Finally, Chapter 5 summarises the findings of the thesis, synthesises the conclusions and draws lessons for future work.

1.4.1 A note on literature reviews

In medical education, literature reviews typical use different strategies depending on the research aims (Haig and Dozier 2003). Because of the varied focuses and approaches in each section, separate literature reviews are included in each chapter. This is particularly important because of the (controversial) role that literature review plays in grounded theory (Chapter 3), but also keeps the presented literature closest to the content that relates to it.

1.4.2 Reflections

Each chapter concludes with some reflections on the work presented and comments on my own development as a researcher. This is particularly relevant for Chapter 2 – the published paper on student priorities – as an early example of my research being disseminated to a wider academic audience.

Chapter 2 Student Priorities

2.1 Introduction

This thesis rests on the connection between learning together and promoting clinical competence. For those interested in designing such learning, this prompts questions about the medical curriculum– 'the planned learning experiences of a school or educational institution' (Prideaux 2003).

While the overall aim of this thesis was to investigate peer learning itself, this chapter steps back to assess where peer learning might fit in a curriculum. We have already seen that peer learning has a strong role in classroom-based work (Chapter 1, section 1.1). I present a paper written early in the development of my research which acts as a kind of reality check on the feasibility of promoting peer learning in the *clinical* setting of wards and clinics. Without such baseline review, any exploration of peer learning could be of marginal relevance. Worse, putative teaching projects may come across significant, even fatal challenges that could have been avoided through a careful initial survey. This pilot work therefore provided a foundation to my understanding of the area, before moving on to the more advanced work in Chapters 3 and 4.

As the manuscript below outlines, a desirable feature of curricular design is the inclusion of the student perspective, with advantages including student empowerment and engagement, development of leadership and management skills at an early stage, and the discovery of parts of the curriculum that students struggle to understand (Visser *et al.* 1998, Finucane *et al.* 2001). This last point is particularly important when it comes to setting educational objectives and judging their attainment – only half of students understood the language of one assessment framework (Lomis *et al.* 2017), and there is often a significant discrepancy between learners and supervisors when it comes to estimating competence (Tallentire *et al.* 2011). If a new form of teaching (such as peer learning) is planned, it must therefore be compatible with what matters most to students, and they must be able to understand what is required to meet the requirements (Prideaux 2003).

While Chapter 3 explores the student perspective on peer learning itself, the work presented here asks what matters most at medical school in general. If peer learning is very low priority, the expansion of peer learning would be more challenging. If it is of higher priority we could hope for greater success. Similarly, we could gain insights in how to communicate this to students in a way they understand.

Furthermore, we could expect to improve the implementation of peer learning by understanding what else matters. This may include, for example, ensuring that peer learning does not conflict with another key priority, or addressing that conflict with students directly to reach consensus. It may also be possible to address multiple concerns with one peer learning approach. I return to these issues in the conclusion, to emphasise how my research approach changed after completing this work.

The research question is therefore:

- What are medical students' main educational priorities?

I asked students what matters most in their education , and interpreted this through the lens of curriculum design, particularly the popular approach of Competency Based Medical Education, CBME. CBME is 'an outcomes-based approach to the design, implementation, assessment and evaluation of medical education programs, using an organizing framework of competencies' (Frank *et al.* 2010, p. 641). These competencies are a description of what the competent physician must be able to do in order to practise safely. It aims to be holistic, with these competencies guiding how we design and assess students to reach these goals. While it has significant detractors (Boyd *et al.* 2018) it remains a popular approach, influencing the way that competence is defined in the UK, the USA and Canada (Federation of State Medical Boards of the United States and the National Board of Medical Examiners 2014, Frank *et al.* 2015, General Medical Council 2015). It is therefore an appropriate way to consider the student perspective on curricular design and educational priority setting.

While the paper itself focuses primarily on this aspect, the conclusion of this chapter will draw out the aspects of the work that are most relevant for peer learning.

2.1.1 Note on research approach and data

The paper describes the theoretical framework taken as constructivist, where social reality is taken as a shared and interpretive creation (Guba and Lincoln 1994). This was deemed appropriate since the concern was to emphasise the richness of the student perspective on their learning, whilst acknowledging the prominent role my own views as a researcher will have on interpreting and creating that perspective. I chose Thematic Analysis as the data analysis method (Braun and Clarke 2006) and include commentary on my own role in the work, in keeping with the principles of reflexivity in qualitative analysis (Mauthner and Doucet 2003). Given the formative nature of this work, I will conclude with some reflections on the way that this work helped me develop as a researcher.

Again I note that the data presented here is based on the same interviews as in Chapter 3 (see Section 1.3.3.4). The method section of the paper and the discussion section of this chapter elaborate on how this data was used. Details of method including ethical safeguards and data collection is described in the paper (page 2 of the manuscript). The recruitment process is the same for Chapters 2 and 3: for brevity this is dealt with in detail in section 3.6. Regarding demographics, 9 female and 7 male volunteers were interviewed; 4 were international students and the rest were of UK origin. From a data collection and confidentiality perspective, details such as age, academic ability etc were not considered critical for the research questions. Moreover, with a small cohort, greater detail carries increasing risk of student identification ; e.g. there may be very few male students of a given age or ethnic background in the class.

2.2 Published Paper on Student Priorities

The attached paper was published online by the Taylor and Francis publication The Medical Teacher on 20th March 2018 (Storrar *et al.* 2019). In accordance with the copyright agreement it is reproduced here as part of a thesis that 'is not to be published commercially'. The co-authors to the paper are my supervisors Helen Cameron and David Hope. They provided critical discussion of the research design, methodology and publication. They also reviewed my coding and analysis to confirm their agreement with its conclusions which we discussed together. However, the interviews and primary analysis were my own, and I wrote the manuscript first draft.

Note the word count for this paper (without bibliography) is 4195.

MEDICAL TEACHER, 2018
https://doi.org/10.1080/0142159X.2018.1450496

Student perspective on outcomes and process – Recommendations for implementing competency-based medical education

Neill Storrar[a], David Hope[a] and Helen Cameron[a,b]

[a]Centre for Medical Education, Edinburgh Medical School, The University of Edinburgh, Edinburgh, UK; [b]Aston Medical School, Aston University, Birmingham, UK

ABSTRACT

Purpose: Competency-based medical education (CBME) seeks to prepare undergraduate and postgraduate trainees for clinical practice. Its major emphasis is on outcomes, but questions about how best to reach these remain. One key issue is the need to integrate what matters most to students when setting educational goals: this is crucial if we are to design curricula that trainees understand and engage with, and that promote successful achievement of competencies.

Method: We interviewed medical students in years 4 and 6 of a 6-year medical degree and used thematic analysis to understand their main educational priorities and how these fit with the aims of CBME.

Results: Two major themes emerged: features of content and process. For content, students wanted clear guidance on what constitutes competence, finding broad outcome statements abstract and difficult to understand as novices. They also attach critical importance to features of process such as being welcomed, included in clinical teams and being known personally – these promote motivation, understanding, and professional development.

Conclusions: We present recommendations for those designing CBME curricula to emphasize the student perspective: what kind of guidance on outcomes is required, and features of process that must not be neglected if competence is to be achieved.

Introduction

Competency-based medical education, CBME, emphasizes that medical curricula should prepare students for real practice. Since studies continue to report medical graduates' lack of readiness for key roles such as acute care and team work (Tallentire et al. 2012; Monrouxe et al. 2017), it is clear that there is more work to be done. CBME is "an outcomes-based approach to the design, implementation, assessment, and evaluation of medical education programs, using an organizing framework of competencies" (Frank, Snell, et al. 2010); it relates competencies to what doctors need for safe practice and examines how we assess and demonstrate competencies to regulatory stakeholders. Such competencies have been defined in multiple contexts such as the Canadian CanMEDS framework (Frank et al. 2015) and the UK General Medical Council's Outcomes for Graduates (GMC 2015). In the European context, these standards are closely linked to the Bologna Process for harmonizing the way learning outcomes are specified and tied to course structure (Cumming and Ross 2007, Patrício and Harden 2010). The CBME movement is examining how to refine these outcomes (Englander et al. 2017) and redesign training to meet them, but has encountered challenges including problems of resource management, stresses on staff, and implementation problems (Holmboe et al. 2017).

A particularly important concern is how to integrate the student perspective in CBME. Medical students struggle to understand competency frameworks, with only 53% of students in one study agreeing that they understood the *language* of a "milestone" competency assessment (Lomis et al. 2017). Furthermore, there is significant discrepancy between student self-reported competence and supervisor views: compared with supervisors, students over-estimated their ability in 11 out of 13 key clinical domains (Tallentire et al. 2011). These findings suggest a significant gap between the clinician's and trainee's understanding of good practice and a need to find better ways to indicate what is required of the learner. Bridging this communication gap may be even more important for designers of national exams such as the United States Medical Licensing Exam (USMLE 2014), the planned UK medical licensing assessment (Melville 2017), and in new forms of assessment such as entrustable professional activities (EPAs) and milestones (Harris et al. 2017).

Despite the primary emphasis on curriculum outcomes, and the freedom that educators have to reach these (Frank, Snell, et al. 2010), CBME literature is also concerned with identifying aspects of process that are required, whether in assessment (Harris et al. 2017) or in the use of time,

Practice points

- Students want clear guidance on what constitutes competence – broad outcome statements are difficult for novices to understand.
- In focusing on competence, elements of process must not be forgotten. This includes promotion of inclusion, understanding by praxis, and providing opportunities for pursuing special interests at any time. This will promote student motivation for learning and achieving competence.

CONTACT Neill Storrar Neill.Storrar@ed.ac.uk Centre for Medical Education, Edinburgh Medical School, The University of Edinburgh, The Chancellor's Building, 49 Little France Crescent, Edinburgh EH16 4SB, Scotland, UK

technology and staff development (Nousiainen et al. 2017). No freedom is absolute. Furthermore, regulators describe the process features required for a quality programme, in guidance such the GMC's "Promoting Excellence" document (GMC 2016), and the World Federation for Medical Education's Quality Improvement Standards (WFME 2015). Such guidance is underpinned by research that finds that process variables such as class size or quality of feedback are better indicators of quality than educational products such as grades or postgraduate attainment (Gibbs 2010).

In summary, to implement CBME well we must describe the intended learning outcomes in ways that are clear to students and identify appropriate principles of process to help us reach these goals. Only then will we achieve "constructive alignment" alignment of teaching methods, assessment, and goals (Biggs 1996).

When considering such curriculum design challenges, collaboration with students has been promoted to ensure their unique perspectives are included (Huppatz 1996, Visser et al. 1998, Finucane et al. 2001). Benefits include access to insights about the "hidden curriculum" of tacit learning not formally taught (Snyder and Snyder 1973), student empowerment from involvement in decision making, preparation for future managerial work, and identifying content areas that students find particularly challenging (Visser et al. 1998). It is therefore imperative that we include student voice when considering design of CBME curricula. We can seek student views on what is important, and consider how student views align with the stated goals of CBME.

This study used in-depth semi-structured interviews to explore what students consider most important in relation to their learning in an outcomes-based undergraduate medical curriculum aligned with a national competency framework. We aimed to identify features of training that students consider most important, and make comparisons with the aims set by CBME. We hoped to identify features of *effective* learning for competency achievement. This would allow us to work cooperatively with students in designing CBME curricula that they understand, promote achievement of competence, satisfy stakeholders, and ultimately benefit patient care.

Methods

This study was carried out in a 5–6 year undergraduate medical course in the UK. The programme delivers an outcomes-based curriculum aligned to the UK GMC's Outcomes for Graduates (GMC 2015), a national competency framework. Students typically enter directly from school, and up to 1/5 are from outside the UK. The course includes clinical exposure from the outset but Years 1 and 2 predominantly focus on basic sciences and medical humanities. Most students undertake an "intercalated honors degree" in related science or humanities subjects in Year 3. In Years 4–6, the majority of the course is in the clinical environment: hospitals and community practice.

Given CBME's emphasis on preparation for practice, students in the more clinical years 4, and subsequently year 6, were invited by open invitation in person at the end of routine teaching sessions. Volunteers contacted the first author by email to arrange an interview.

Ethical safeguards to protect student confidentiality included strict data protection, private interview, and use of aliases for quotations. So that participation could not prejudice future student performance, the interviewer agreed to abstain from examining participants at future summative assessments. To allow informed consent, students were given written information and a copy of the consent form prior to attendance. Support contacts were provided in case of unexpectedly upsetting matters arising, and consent could be withdrawn where possible (data not embedded in analysis or publication). This study was approved by the College of Medicine and Veterinary Medicine Student Ethics Committee.

Students were interviewed for an hour. The researchers developed a semi-structured topic guide by consensus discussion. We explored questions of students' overall priorities and goals, and their perceptions of what was important in reaching these goals.

We used an inductive approach to allow priorities to be grouped by student responses rather than a pre-conceived framework, in keeping with a focus on student-led views. Interview data were analyzed using thematic analysis aiming to find latent themes to describe underlying concerns that might link related concerns across the study population (Braun and Clarke 2006). Coding was primarily by the first author, with review by the other two authors to ensure all relevant themes were considered and coherent. Coding proceeded through the steps suggested by Braun and Clarke: familiarization, initial codes, search for themes, reviewing themes, and theme definitions (Braun and Clarke 2006).

The theoretical framework was taken to be constructivist focusing on recreating student perceptions of what matters, while recognizing that the researcher's own perspective influences the development of these perceptions and their analysis (Guba and Lincoln 1994). The lead researcher therefore included self-interviewing to record his own position and views, and we considered how this may influence the data collection and analysis (Mauthner and Doucet 2003). Collection proceeded towards data sufficiency – the aim was not to provide an exhaustive "data saturated" account of all possible student concerns (Varpio et al. 2017), but identify common and recurring themes in an informative study population. Following 13 initial interviews, a further 3 students were recruited which satisfied our requirements.

Results

Our results identify students' main priorities at medical school and the features they consider important for reaching them. These goals are diverse, but analysis illuminated themes of *content* and *process* (Table 1). These have various components e.g. content includes achieving high exam scores and clinical competence; process includes having personalized teaching and fostering good relations with peers and patients. We expand on key features here. Quotations use pseudonyms.

Content

Students expressed a strong desire to know what is required to reach clinical competence. This was most

Table 1. Student priorities grouped by theme.

Focus on content	Focus on process
Being the best	Being known and personal identity
Exams and ranking	Recognition of achievement
Curriculum vitae	Personalized teaching and feedback
	Being welcome
	Reputation and prestige
Preparation for practice	Feeling useful
Competence	Part of the team
Avoiding Error	Learn by praxis
	Looking after patients
	Satisfying clinical experience
Personal Development	Good relations
Non-technical skills	Peers and family
Develop wisdom	Staff and faculty
Develop autonomy	Patients
A sense of wonder	
	Fairness and comparisons with peers
	Being part of something big
	Happiness and Stress Control

Students were asked what mattered most at medical school and answers were grouped according to the emergent themes. Some priorities had a greater emphasis on elements of content, and others on elements of process.

evident in goals related to academic achievement. They value *detailed* outcomes and standards, and find high-level behavioral descriptors vague:

> Rebecca: I know [infectious disease] is important, but how much about the importance of it and… the detail do you want me to know? [Some guidance is] much better: you need to know em… the typical presentation, the common drugs used to treat… the gold standard for diagnosis. So it's more useful when you have specific stuff we need to learn about

Understanding outcomes goes beyond knowing what would come up in the end of year assessment. There is a genuine fear that patients may suffer if aspects of knowledge and skill are not known. We also noted a concern that emphasizing skills such as communication and empathy without attention to knowledge content could impair competence:

> Kelly: I'm just nervous I'm going to graduate and get out there and just sort of fail my patients because, you know, they come in with a symptom and I'm like, oh, that sucks, and can be nice to them and sympathetic but then have no idea what's wrong with them.

We found evidence that students wanted to be able to go beyond core competence and learn for its own sake – learning for this "sense of wonder" (Table 1) was described as highly motivating:

> Imran: I guess ideally you learn throughout the term and you're learning everything. Exam time, it's not fun to cram, but it is fun to learn. Actually knowing stuff I feel a bit more like a doctor. Learning for fun is far more interesting, or learning for the sake of learning rather just learning for the exam

Process

Across numerous clinical, academic, and extracurricular goals, the crucial feature was inclusion. When students felt they were part of a team, had built relationships with their colleagues or peers, and were known as individuals, they saw learning as far more effective. Indeed these were considered valuable goals in themselves (Table 1).

Building relationships was partly about the need to be fairly judged and get personalized feedback, but such inclusion was also *motivating* for engagement with learning:

> Robert: You can build a personal relationship with someone, even if it is relatively superficial, just for four weeks or whatever, you feel valued and therefore you feel more motivated to try and work at that particular topic.

In relation to preparation for practice students expressed a strong desire to learn by praxis – knowing the standard by taking part in real clinical care:

> Robert: Ward time is valuable [because] you get a list of conditions which can occur on the ward and therefore what you should know: the aspects of care that are required for them to be treated. So like if someone comes in with a heart valve issue you know you've to do an echocardiogram. No one told me that in the first two weeks, but I learnt that from the ward because people were like, oh yes, he's waiting for his echo.

In addition, inclusion in clinical work promoted a sense of usefulness, encouraged students to work with their peers, and avoided perceptions of being marginalized or a burden to patients, a known risk with more passive observation:

> Olga: I think there was always a sense that we aren't doing much… we aren't really contributing very much to their care and we just… yes, especially when we were taking history from patients with metastatic diseases who were in palliative care. I think they were generally still happy to speak to us but we did feel like that was very generous of them to go through that again.

Finally, these themes overlap, and it is important to note that priorities were not strictly stratified: students talked about balancing these, or choosing which to focus on at any one time:

> Richard: If you can achieve that balance, if you can pass your exams clearly as well as doing plenty of other things, as well as meeting plenty of other non-medics, then if you can say you've done that, throughout your time in medical school, that would be great to look back on

Discussion

We started by asking students about their general priorities and what matters in learning, and quickly reached a deeper understanding of features of content and process that identify strong reasons to include the student voice when planning implementation of CBME.

Students agree that preparation for practice is a key goal which fits with the overarching goal of CBME. However, they would like *very specific* guidance on the standards and content required for safe practice. They find high-level descriptions difficult, and have great anxiety about having "gaps" in knowledge and ability. Students also expressed interest in learning *beyond* basic competence – learning for its own sake or pursuing special interests. This was reported to be highly motivating.

There was also significant concern with processes for reaching competence: how teaching is delivered and in which contexts. A main concern is with being known as an individual, receiving personalized feedback and support as well being useful as part of a team. Learning through participation in real patient care was important to identify

what matters in clinical practice. Again this was linked to more effective achievement of CBME's aims.

Previous critiques of learning outcomes have identified student difficulties in understanding terminology of outcomes (Prideaux 2004). In the more recent discussion of competency frameworks, some concerns were raised by students about the language of "milestone" assessments (Lomis et al. 2017), which supports our findings. This study adds to this by pointing out how much stock students put in *detailed* content description as opposed to broad statements of intended competence or learning outcomes. There is a risk of reductionism with competency frameworks where lists of outcomes are split to unmanageable levels of detail (Frank, Snell, et al. 2010), but the opposite difficulty exists too: broad high level descriptors can frustrate students with their open-endedness. Such high-level descriptors are found in the competency frameworks referenced above, and in Europe the Bologna process specifies that only a small number of broad programme outcomes are described, with a similar number of more granular outcomes for each module. Achieving the right level of detail to guide student learning is therefore problematic.

Proponents of CBME argue that it aims to ensure competence in dealing with the potentially limitless nature of learning (Holmboe et al. 2017) and is supported in this aim by formative assessment and feedback which helps students judge what is required to achieve the competence statements and progress (Harris et al. 2017). But this sidesteps the challenge of how to indicate the required competencies to both trainees *and* their teachers in ways that are comprehensible and useful when preparing tomorrow's doctors for practice. Again this is pertinent for those designing and sitting national examinations, not least because traditional content-based assessments are likely to still be of use in CBME (Hawkins et al. 2015).

While students' desire for detailed guidance spoke of the need to know what the basic standard is, we also found views that questioned the focus on "core" topics. When setting outcomes, "dumbing down" to minimal competence is a known risk that must be countered by educators (Frank, Mungroo, et al. 2010). In this study, students added support to this view, expressing nervousness about minimal competence. Achieving a "just passing" standard was considered inadequate, and students were concerned about encountering specialist situations and diseases they were not prepared to manage. This included areas of "expert" knowledge beyond the immediate period after qualification.

Students also want to follow areas of non-essential study as part of a "sense of wonder," considering this highly motivating. While there is some suggestion that those who achieve competence quickly can then have their learning enriched in other ways (Nousiainen et al. 2017), this sequential detachment of "basic" and "extra" training would seem to defer the motivational element. Self-determination theory suggests that "internal motivators" such as patient-contact should be introduced early in curricula (Ten Cate et al. 2011); we suggest that "a sense of wonder" related to special interest is such an internal motivator.

Others have also identified concerns with process versus outcomes, arguing that if the emphasis is heavily on outcomes then students risk being overlooked and disengaged (Rees 2004). Students in this study identify the powerful impact of inclusion on their efforts to learn. Again this can be viewed from a self-determination perspective, reflecting the importance of a sense of belonging/relatedness as one of 3 key components of internal motivation (Ryan and Deci in Kusurkar et al. 2012). Inclusion of students can have service benefits too, where students add value to clinical care (Gonzalo et al. 2017).

Finally, we find that inclusion incorporates development of personal identity, a feeling of welcome and psychological support, and mitigation of stresses of student-faculty interactions. If CBME were to focus *only* on measurement of competencies in the workplace it could alienate learners (Brightwell and Grant 2013). For example, a clinical clerkship that includes frequent contact with supervisors might allow their competence to be assessed well, but this does not necessarily make learners feel supported. Educators must find ways to balance the requirements of assessment with pastoral needs.

Recommendations

The exploration of student perspectives on learning outcomes or CBME leads us to suggest several key recommendations.

If we are to avoid confusing or disengaging students, curriculum information must include detailed guidance on what constitutes competence, developed with and for students. Guidance should be clear enough to be understood by novices at the outset of each stage of learning, and truly help them prepare for clinical responsibilities *and* assessment. Broad outcomes statements should be complemented by descriptions of content that detail the contexts of practice – such as key presentations, diseases and settings – that students should *prioritize* in their learning. This might necessitate modification of international or national guidance on how to define outcomes, particularly where national assessments are required. While new approaches to feedback and assessments such as EPAs may also help learners understand what they need to achieve (Harris et al. 2017), there remains the possibility that teachers may not have a shared view of the priorities in the absence of details. The USMLE and the planned UK MLA are likely to continue to use traditional forms of assessments (USMLE 2014; Melville 2017); thus student-centred guidance on what learning to prioritize for these national assessments is key.

Complementing this guidance, and in common with others interested in CBME, we emphasize the importance of learning by real involvement in clinical environments and integration in clinical teams (Carraccio and Englander 2013). This can aid fair assessment of competence, (Lockyer et al. 2017), but practical experience will also add *salience* to what can be abstract outcomes. This can be achieved through greater workplace integration, for example in student apprenticeships (GMC 2009).

We also advise caution in the sequential separation of "basic" and "extra" learning, because of the risk of hampering internal motivation outlined above. We support calls for better understanding the role of self-determination in relation to competence (Ten Cate et al. 2011; Gruppen et al. 2017).

The tension between inclusion and workplace assessment must also be recognized, and we recommend caution when clinicians are given dual roles as assessors and teachers.

Strengths and limitations

This study used rigorous methodology to explore the concerns of medical students on clinical placements, a highly relevant group when considering preparation for practice. Open questioning allowed students to highlight all areas that matter – even if we had not considered them previously – rather than forcing the question to be about learning outcomes or competency approaches directly. The thematic analysis using an interpretive framework appropriate to the question, and individual interviews allowed us to confront inconsistencies, and develop underlying connections.

Regarding transferability of findings, while the study is not in a fully-fledged CBME curriculum, it is from an outcomes-based curriculum aligned to a competency framework; these findings are likely to resonate with other institutions in a similar position. Saturation is a potential issue, but we argue that it was sufficient – the detailed interviews, rapid development of important themes and focus on one area of interest (student main goals) all argue for a smaller sample size (Varpio et al. 2017). After an initial sample of 13 students, we interviewed 3 more and no significant new themes were identified. While a larger sample could have uncovered other priorities, we consider it unlikely that the core concerns of process and content would be significantly different.

Consideration of the researchers' roles is important (Mauthner and Doucet 2003). The first author is a physician who trained in the same university as the students. His research interest is in learning in the clinical environment. Although we introduced the notions of content and process in the introduction to this manuscript, these were themes that emerged over the course of the data analysis. Still, we recognize that theme development is not inextricable from the researcher's interest in improving educational methods, which includes ideas of process.

Conclusions

This paper has identified matters of importance to students that educators must attend to if they are to collaborate with students for effective curriculum design.

First, we emphasize the challenges in communicating outcomes: students continue to express the need for detailed guidance on what they need to know and do. This remains important even in competency-based approaches. This will help align what students and staff consider to be good practice.

Second, inclusion of students in teams and working environments goes beyond developing reliable or valid workplace-assessment of competency. Inclusion is itself a marker of quality education where students are valued and develop their professional identities in nurturing surroundings. We note that the need to assess in the workplace may conflict with the need for support and inclusion: there are potential tensions between assessing competency and student inclusion.

Future work should address:

- Experience of implementing policies and curriculum design approaches that integrate these concerns
- The impact of detailed guidance on student comprehension and achievement of outcomes and competencies.
- Identifying optimal methods to achieve a balance between authentic workplace based assessment and providing students with a sense of inclusion and support.

Incorporating these issues of content and process in curriculum design is difficult, and requires good process management. We strongly emphasize the importance of process not just as a means to reach competence but as an end in itself.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Funding

This project was supported by the University of Edinburgh Principal's Teaching Award Scheme, receiving a small grant award in Spring 2017.

Glossary

- **Competency-Based Medical Education**: An outcomes-based approach to the design, implementation, assessment, and evaluation of medical education programs, using an organizing framework of competencies.
- **The Bologna Process**: Is an EU wide agreement in Higher Education that commits member states to a process of harmonization and convergence.

Notes on contributors

Dr Neill Storrar, BSc, MBChB, PgDipClinEd, is a doctor training in hematology, currently working as a clinical fellow in medical education. He is a fellow of the Higher Education Academy. His interests are in the learning environment and peer learning.

Dr David Hope, MA, MSc, PhD, is a psychometrician specializing in assessment and feedback. A fellow of the Higher Education Academy, he is closely involved in the assessment of undergraduate and postgraduate medical students. His previous work has received a Teaching Innovation Award from the International Association for Medical Education.

Professor Helen Cameron, BSc, MBChB, is the Dean of Medical Education at Aston Medical School and is leading the implementation of a new medical programme there. Previous to this she was Director of the Centre for Medical Education at the University of Edinburgh 2003–17 where she led educational innovation and research.

ORCID

Neill Storrar http://orcid.org/0000-0002-4548-6468

References

Biggs J. 1996. Enhancing teaching through constructive alignment. High Educ. 32:347–364.

Braun V, Clarke V. 2006. Using thematic analysis in psychology using thematic analysis in psychology. Qual Res Psychol. 3:77–101.
Brightwell A, Grant J. 2013. Competency-based training: who benefits?. Postgrad Med J. 89:107–110.
Carraccio CL, Englander R. 2013. From Flexner to competencies: reflections on a decade and the journey ahead. Acad Med. 88:1067–1073.
Ten Cate OTJ, Kusurkar RA, Williams GC. 2011. How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE Guide No. 59. Med Teach. 33:961–973.
Cumming A, Ross M. 2007. The tuning project for medicine – learning outcomes for undergraduate medical education in Europe. Med Teach. 29:636–641.
Englander R, Frank JR, Carraccio C, Sherbino J, Ross S, Snell L, on behalf of the ICBME Collaborators. 2017. Toward a shared language for competency-based medical education. Med Teach. 39:582–587.
Finucane P, Nicholas T, Prideaux D. 2001. The new medical curriculum at Flinders University, South Australia: From concept to reality. Med Teach. 23:76–79.
Frank JR, Mungroo R, Ahmad Y, Wang M, De Rossi S, Horsley T. 2010. Toward a definition of competency-based education in medicine: a systematic review of published definitions. Med Teach. 32:631–637.
Frank JR, Snell LS, Cate O, Ten Holmboe ES, Carraccio C, Swing SR, Harris P, Glasgow NJ, Campbell C, Dath D, et al. 2010. Competency-based medical education: theory to practice. Med Teach. 32:638–645.
Frank JR, Snell L, Sherbino J. 2015. CanMEDS 2015 Physician competency framework. Ottawa: Royal College of Physicians and Surgeons of Canada.
Gibbs G. 2010. Dimensions of quality. York: Higher Education Academy.
GMC. 2009. Clinical placements for medical students. Manchester: General Medical Council.
GMC. 2015. Outcomes for Graduates. Manchester: General Medical Council.
GMC. 2016. Promoting excellence: standards for medical education and training. Manchester: General Medical Council.
Gonzalo JD, Dekhtyar M, Hawkins RE, Wolpaw DR. 2017. How can medical students add value? Identifying roles, barriers, and strategies to advance the value of undergraduate medical education to patient care and the health system. Acad Med. 92:1294–1301.
Gruppen L, Frank JR, Lockyer J, Ross S, Bould MD, Harris P, Bhanji F, Hodges BD, Snell L, ten Cate O, on behalf of the ICBME Collaborators, et al. 2017. Toward a research agenda for competency-based medical education. Med Teach. 39:623–630.
Guba EG, Lincoln YS. 1994. Competing paradigms in qualitative research. In: Denzin N, Lincoln YS, editors. Handbook of qualitative research. Thousand Oaks (CA): Sage; 105–117.
Harris P, Bhanji F, Topps M, Ross S, Lieberman S, Frank JR, Snell L, Sherbino J, on behalf of the ICBME Collaborators. 2017. Evolving concepts of assessment in a competency-based world. Med Teach. 39:603–608.
Hawkins RE, Welcher CM, Holmboe ES, Kirk LM, Norcini JJ, Simons KB, Skochelak SE. 2015. Implementation of competency-based medical education: are we addressing the concerns and challenges? Med Educ. 49:1086–1102.
Holmboe ES, Sherbino J, Englander R, Snell L, Frank JR, ICBME Collaborators 2017. A call to action: the controversy of and rationale for competency-based medical education. Med Teach. 39: 574–581.
Huppatz C. 1996. The essential role of the student in curriculum planning. Med Educ. 30:9–13.
Kusurkar RA, Croiset G, Mann KV, Custers E, ten Cate O. 2012. Have motivation theories guided the development and reform of medical education curricula? A review of the literature. Acad Med. 87:735–743.
Lockyer J, Carraccio C, Chan MK, Hart D, Smee S, Touchie C, Holmboe ES, Frank JR. 2017. Core principles of assessment in competency-based medical education. Med Teach. 39:609–616.
Lomis KD, Russell RG, Davidson MA, Fleming AE, Pettepher CC, Cutrer WB, Fleming GM, Miller BM. 2017. Competency milestones for medical students: design, implementation, and analysis at one medical school. Med Teach. 39:1–11.
Mauthner NS, Doucet A. 2003. Reflexive accounts and accounts of reflexivity in qualitative data analysis. Sociology. 37:413–431.
Melville C. 2017. Report on the Medical Licensing Assessment consultation. Manchester (UK): General Medical Council.
Monrouxe LV, Grundy L, Mann M, John Z, Panagoulas E, Bullock A, Mattick K. 2017. How prepared are UK medical graduates for practice? A rapid review of the literature 2009–2014. BMJ Open. 7:e013656
Nousiainen MT, Caverzagie KJ, Ferguson PC, Frank JR. 2017. Implementing competency-based medical education: what changes in curricular structure and processes are needed?. Med Teach. 39:594–598.
Patrício M, Harden RM. 2010. The Bologna process – a global vision for the future of medical education. Med Teach. 32:305–315.
Prideaux D. 2004. Clarity of outcomes in medical education: do we know if it really makes a difference? Med Educ. 38:580–581.
Rees CE. 2004. The problem with outcomes-based curricula in medical education: insights from educational theory. Med Educ. 38:593–598.
Snyder BR, and, Snyder BR. 1973. The two curricula. Cambridge, MA: The MIT Press.
Tallentire VR, Smith SE, Skinner J, Cameron HS. 2012. The preparedness of UK graduates in acute care: a systematic literature review. Postgrad Med J. 88:365–371.
Tallentire VR, Smith SE, Wylde K, Cameron HS. 2011. Are medical graduates ready to face the challenges of foundation training?. Postgrad Med J. 87:590–595.
USMLE. 2014. Physician tasks/competencies. Philadelphia (PA): The United States Medical Licensing Exam.
Varpio L, Ajjawi R, Monrouxe LV, O'Brien BC, Rees CE. 2017. Shedding the cobra effect: problematising thematic emergence, triangulation, saturation and member checking. Med Educ. 51:40–50.
Visser K, Prince KJ, Scherpbier AJ, van der Vleuten CPM, Verwijnen GM. 1998. Student participation in educational management and organization. Med Teach. 20:451–454.
WFME. 2015. Basic medical education WFME global standards for quality improvement – the 2015 revision. Copenhagen: WFME Office.

2.3 Post-paper discussion

The above paper emphasised the important of good process as well as comprehensible outcomes when designing a curriculum. It yielded specific lessons for those designing curricula for the clinical setting such as the emphasis on student inclusion in clinical teams and the importance of having clear guidance on what learning is expected. There are many aspects that warrant further exploration, but I will focus on how it impacts on peer learning. The discussion cites relevant peer learning literature, with much wider and more comprehensive literature reviews in Chapters 3 and 4. In this section I will also describe how the above paper influenced my research presented in this thesis and reflect on my own development as a researcher.

2.3.1 Implications for peer learning

The domain of peer learning overlaps with many elements of the wider curriculum, from assessment (Topping 2009) to clinical skills (Basehore *et al.* 2014) and medical professionalism (Kovach *et al.* 2009). It is perhaps unsurprising then that there are multiple areas where peer learning could be seen to help students reach the goals identified in the paper above. Students value the building of relationships, and this is thought to be a positive feature of peer learning in general, with one systematic review emphasising the social benefits (Tai, Molloy, *et al.* 2016). If peer learning does indeed improve performance as many studies suggest (Tolsgaard *et al.* 2013, Tai, Molloy, *et al.* 2016), it should help attain the overall goal of 'Preparation for Practice'. Students also prioritised the opportunity to compare themselves with their peers. Peer learning offers a natural setting for this, through vicarious learning (St-Onge *et al.* 2013). These and other benefits advocate for the expansion of peer learning (Ten Cate and Durning 2007a, Tai *et al.* 2017). An ideal peer learning approach should promote all of these priorities.

Still, educators should take notice of student priorities that may conflict with peer learning. For example, how do we reconcile peer learning as a collaborative exercise with the individualist appeal of 'being the best'? While students expressed a desire to form good relations with their peers, they also

value ‘stress control’. Since comparisons with peers is cited as a contributor to medical student stress (Radcliffe and Lester 2003, Lempp and Seale 2004) increasing peer-peer comparison in the context of peer learning could cause problems. Similarly, the avoidance of error is important to students, and we can imagine their worries about being taught erroneous information by a peer, or at least preferring a qualified doctors’ teaching (Bennett *et al.* 2015). These pitfalls of peer learning must be addressed if we are to design better peer learning experiences that students value and that do not increase unhelpful stress.

This paper provides some insights into how this could be done. It emphasised the importance of clear and comprehensible learning outcomes; peer learning may contribute to this goal by encouraging students to discuss what constitutes good performance (Topping 2009). If the activity itself clarifies the standard expected – perhaps being aligned with assessment criteria (Biggs 1996) or demanding a skill required of graduates – peer learning could address the concerns about understanding criteria.

Since students value the building of relationships, peer learning could have this as a surrogate aim and alter design accordingly. This could take the form of measures to promote group bonding such as efforts to keep groups together for enough time to let bonds form, or including social events and activities. Since students want ‘personalised feedback’, peer learning could include methods for giving students quick and helpful critique of their work to date, again a theoretical benefit of peer learning (Topping 2009).

One challenge for peer learning in the clinical setting requires particular mention. Something valued by students was ‘inclusion in clinical teams’; indeed this was seen to be one of the most valuable ways of learning in the clinical context. Peer learning may subvert this, particularly if students are asked to spend a great deal of time in peer-directed learning without clinicians present. While there may be creative solutions, an overemphasis on peer learning could be counterproductive and alienating for students.

2.3.2 Summary of lessons for peer learning

This paper has provided insights on how peer learning should and should not be adapted in the clinical context. The lessons have influenced the succeeding chapters: Chapter 3 focuses on how students make decisions about peer learning, in particular exploring the conflicts highlighted above. Chapter 4 describes the implementation and assessment of a peer learning project Peer Practice that drew on the work on students' priorities. Particular care was taken to integrate assessment criteria to the peer learning activity and to judge whether students found the educational encounters stressful. .

2.3.3 Reflections

One of the aims of this early research was to aid my development as a researcher. The experience was my first practice of analysing qualitative data, and the reading and training I undertook to gain experience in Thematic Analysis carried benefits for the approach taken in Chapter 3's Grounded Theory. For example, it clarified for me the notion of 'data saturation' and how its use differs depending on research context. This is not a term found in my traditional medical education, but refers to the extent to which enough interviews or data have been analysed in order to stop data collection (O'Reilly and Parker 2013). In this paper the approach was 'data sufficiency' – I had enough to satisfy my needs of illuminating the subject at hand, and developing the key themes of content and process (Varpio *et al.* 2017). This is not the same as data saturation where all possible content has been mined – potentially an unreachable state (Varpio *et al.* 2017). In this context the 16 interviews completed at the time of manuscript preparation were considered enough. A different approach was taken in Chapter 3 – theoretical saturation – which will be described and defended there.

Similarly, the writing of this paper was part of my evolving understanding of Pragmatism and how research focus dictates research approach. In this chapter the aim was to develop an understanding of the diversity and richness of student experience; a constructivist approach to the analysis of these interviews seemed helpful. This contrasts with chapter 3, where the

interest was in developing a theoretical model to guide understanding of peer learning. The same interviews were analysed with a different approach called Classic Grounded Theory which aims to create such a model (Glaser 1998).

This study (and work in subsequent chapters) is an example of 'insider' social research where the researcher is part of the same culture under study (Greene 2014). In addition to its influence on study goals and questions (see the manuscript discussion section), this can alter the responses students give, particularly if students saw me as an authority figure or future colleague. There are advantages however (a shared experience with students, knowledge of their context), part of the reason that 'insider research' is increasingly common (Greene 2014).

This paper was also valuable training in publishing and research dissemination. The paper was published in an established journal - 2017 impact factor 2.450 (www.SciJournal.org 2019) - and cited three times as of April 2019. Unexpectedly the first submission of the paper was accepted without revisions.

2.4 Chapter conclusions

This chapter supports the plausibility of peer learning in the clinical setting but identified a need to understand it further. The major lessons include the importance of making the content and process of learning acceptable to students, and to help it reach their other goals such as competence and the control of stress. There are potential conflicts in addressing these goals via peer learning which challenge those involved in instructional design. This challenge is explored in Chapter 3 which develops a theoretical understanding of the things that influence peer learning in the clinical setting. If Chapter 2 has provided the context to how peer learning fits into students' overall goals, Chapter 3 takes the analysis further, focusing specifically on how students make decisions about peer learning. Again, it shares some of the data used in this chapter but as I shall demonstrate, repurposes it to generate a Grounded Theory of Peer Learning in the Clinical Setting.

This chapter has also contributed significantly to my development as a researcher. Through exposure to research interviewing, the analysis of qualitative data, different methodological approaches and the processes of academic writing and publication I have built skills and experience that have directly influenced – and strengthened – the work that follows. As I gained research experience I was able to move on to the more advanced work presented in subsequent chapters.

Chapter 3 Grounded Theory of Peer Learning in the Clinical Setting

3.1 Chapter Abstract

Peer learning is widely used in medical education, but existing literature provides only a partial theoretical understanding of whether and how well students will engage in peer learning. This chapter sets out the rationale for developing a new predictive model of what governs participation in peer learning in the clinical setting using Classic Grounded Theory, CGT. This research method is described and critiqued. The chapter then presents the theory of *Internal Negotiation,* based on interviews with medical students, analysis of data from earlier peer work, and synthesis with existing literature. The theory explains how students overcome their main concern of 'getting ahead while getting along' with their peers. Given an opportunity to take part in peer learning, they may or may not proceed, but if they do they must balance various potentially contradictory social and educational pressures. This balancing process is called *Internal Negotiation* and the three pressures are *Expected Educational Gain, Social Reward* and *Social Risk.* The outcome of the balancing determines current and future behaviours. Whilst many theoretical models in education cover similar notions, few attempt to integrate them and none covers the range of variables and outcomes presented here. The implications of this theory for researchers and teachers are discussed.

3.2 Introduction

In Chapter 2 we saw how peer learning might help medical students and their educators reach their educational objectives: peer learning is plausible. This chapter considers the question in further detail and develops a theoretical model for understanding when peer learning will – or will not – be successful.

The literature that promotes peer learning was discussed in Chapter 1, but these papers do not fully explain the significant problems we might expect with peer learning. To recap, we know that competition between medical students is an oft-cited reason for stress (Radcliffe and Lester 2003, Lempp and Seale 2004), and studies of 'peer assessment' (where students judge one another's performance) have demonstrated substantial misgivings in the student body (Arnold *et al.* 2005, Kovach *et al.* 2009). In short we might ask if peer learning has been oversold. What is needed is a way to understand student behaviours when it comes to peer learning that explains both enthusiasm for peer learning and the reservations they have. The above papers do not adequately address this – an issue that is explored more fully in the literature review.

The purpose of this chapter is to identify what students' concerns and interests are in their engagement with peer learning. A well-established method of developing new theoretical models in medical research is Grounded Theory (Watling and Lingard 2012). The next section describes what this is and why it is useful for this thesis. A new theoretical model should yield valuable advice for those interested in developing peer learning projects whilst mitigating its drawbacks (see Appendix 3 for an example of such guidance).

3.3 Classic Grounded Theory

To explain Classic Grounded Theory, CGT, I will first consider the definition given by one of its co-originators:

> A set of clear, rigorously set procedures that lead to a conceptual theory. GT is comprised of conceptual categories and their properties, which name latent patterns that explain what is going on as people continually solve their main concerns. (Glaser 2005, p. 127).

For Glaser, theory is a set of hypotheses that let researchers predict or explain what is happening in a social phenomenon. It does not seek to test hypotheses or demonstrate the truth of the theory, but rather to establish a plausible understanding of social research issues that are clearly *grounded* in data i.e. relate to the phenomenon under study. In its original description by Glaser and Strauss (1967), this was presented as a critique of prominent social research that sought to verify theories presented by 'great men' such as Max Weber. Glaser and Strauss (1967) argued that this could produce 'thin' accounts that missed the most important issues at the heart of a social scene. Grounded theory could improve on this by applying procedures intended to guide the researcher through the entire process from research conception to final dissemination by publication (Glaser 1998, pp. 12–13). Using this method would safeguard the relevance of the theory to the 'main concern' of the participants. For this thesis, CGT is a way of studying the phenomenon of interest – undergraduate peer learning in the clinical setting – and deriving a plausible theory about their concerns that will guide educators.

3.3.1 Alternative Approaches

The definitions and approaches to grounded theory have been the subject of intense academic debate. Multiple versions of grounded theory are now espoused which have varied interpretations of the researcher's role, how analysis of data should proceed and what data is included (Glaser 2002a, Bryant 2003). For clarity, these will be discussed after the outline of Classic Grounded Theory has been presented, in Section 3.5.

3.4 Summary of CGT Methodology

In this section I will describe CGT methodology, from formulating the research question to writing up the final thesis. With each component I will illustrate how it has applied in my thesis, both for clarity and as evidence of rigorous application of the CGT processes. I will present a relatively detailed account to demonstrate my understanding of it and to make it clear how the theory was derived.

Some key elements are (Glaser 1998, pp. 12–13):

- Open-ended nature of enquiry – the theory cannot be known in advance
- Coding with constant comparison – data analysis takes place through repeated review of all data and identification of 'codes' that name ideas and concepts that are found
- Theoretical Sampling – where data comes from is determined by the evolving theory
- Theoretical Memos – systematic documentation of thoughts and analysis continues throughout the analysis
- Theoretical Coding – the researcher looks for ways of fitting the data together into a unifying structure
- Delaying the literature review – so that the major ideas come from the data, not from other researchers' views
- Writing up the thesis – to synthesise all of the above

When undertaking CGT many of these steps take place simultaneously, but Figure 3-a and Figure 3-b give an idea of how they fit together. The terminology can be confusing (Evans 2013) and will be explained in the rest of the chapter, but a text summary of the process follows the figures.

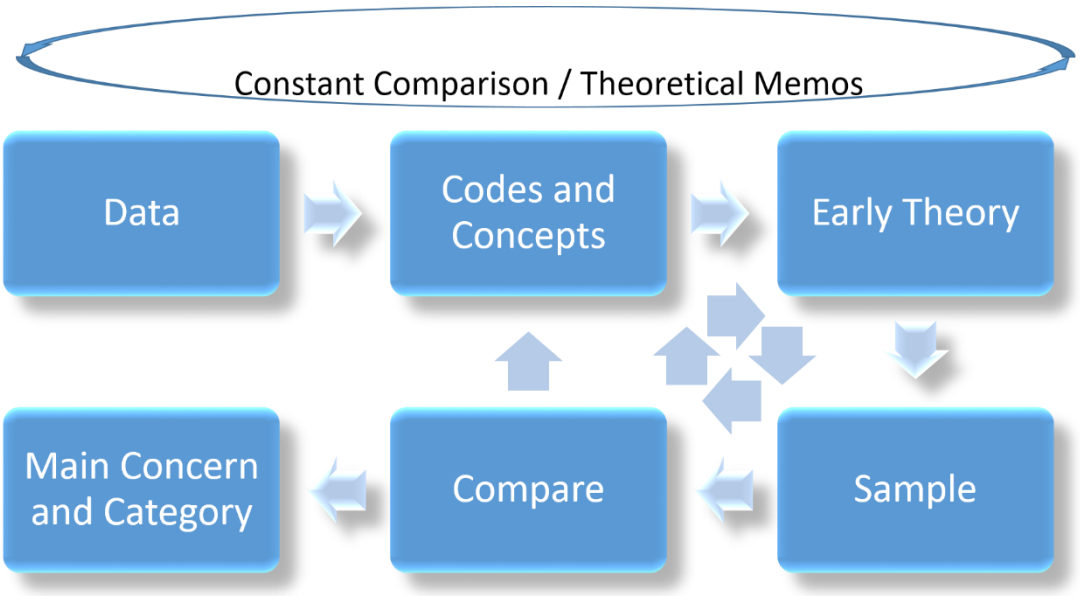


Figure 3-a Open Coding in Grounded Theory

Figure 3-a outlines *Open Coding*. One starts with *data* (often interviews or surveys) and begins classifying all the data: *Open Coding*. By constantly comparing *Incidents* (events and notable ideas) in the data, *Codes* are generated that represent important *Concepts*. As more codes are developed, comparison of these leads to the generation of *Categories* which link codes into larger patterns. *Theoretical Sampling* is when the researcher deliberately looks for a comparison group that could shed light on other aspects of the developing theory. All this is supplemented by copious writing of *Theoretical Memos* to keep track of ideas and connections. Eventually this iterative process results in the identification of a *Main Concern* – what matters most in the social scene – and then a *Core Category* that explains how this is resolved. From here you move to *Selective Coding*.

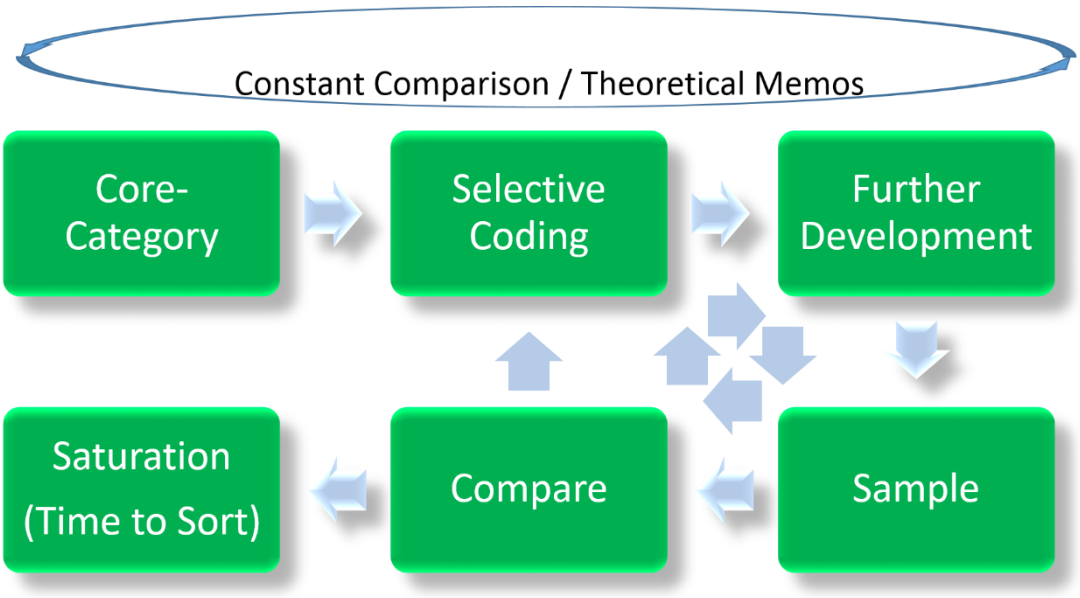


Figure 3-b - Selective Coding in Grounded Theory

Figure 3-b: coding now focuses on incidents most relevant to the *Core Category*. Through multiple cycles of further coding, sampling and comparison, the theory becomes increasingly *Saturated*. This means that further data collection is unlikely to identify new important aspects of the theory. Hereafter the data are integrated into a final theory as outlined in the sections on *Theoretical Sorting* and *Theoretical Sampling* below. Some further sampling may prove necessary but is increasingly focused.

3.4.1 Framing the Research Question – Staying Open

Grounded Theory originated as a way to generate new, plausible theories about the area under study. These theories will be sets of predictions (hypotheses) about what we would expect to happen (Glaser 1998, p. 3). Since it does not set out to *test* theory, *beginning* with hypotheses is not appropriate: the hypotheses are the *product* of Grounded Theory (Watling and Lingard 2012). Instead we ask how people 'resolve a main concern.' (Glaser 1998, p. 115). Glaser insists that we should take multiple steps to avoid imposing our own professional interests on the participants, lest we assume they are attempting to resolve one problematic concern when in fact this is not the main issue. He gives examples of how researchers thought they should be exploring one thing, but instead realised the 'main concern'

was quite different, such as one researcher's report that, 'I was supposed to be doing a study of 'advance directives' before dying, and realized the patients did not care. They were trying to stay alive by beating the odds.' (quoted in Glaser (1998, p. 124)). In other words researchers must ensure any initial assumptions about the issues they are studying are always questioned, and put them aside if they do not seem relevant. Otherwise you 'force' your views on the subject.

In order to avoid this 'forcing,' Glaser advises several strategies including : avoid pre-reading the literature (discussed in section 3.4.11 below), avoid rigid interview schedules; pay careful attention to coding and sampling procedures to ensure all important concepts are identified; self-interview such that one's own views can be integrated into the analysis and are not given undue weight; avoid work in fields where one is already an expert (Glaser 1998).

In this thesis, the initial research questions about how peer learning relates to ideas of competition and collaboration was therefore reformulated to a more general one:

What is the main concern of medical students in relation to peer learning in the clinical context?

The specification of *the clinical context* is reasonable since we must always make some basic decisions on the subject of research. Glaser's and Strauss's early work focused on experiences of death in hospitals (Glaser and Strauss 1965); they could have equally chosen to study birth in hospitals, death on battlefields etc.

Coding and sampling procedures as well as the role of literature will be discussed shortly. Regarding interview schedules, the initial interviews *were* undertaken with some predefined questions (Appendix 1). These endeavoured to be general and avoid leading questions, though as

confidence in CGT methods developed my questions became more fluid, and instead explored aspects of the nascent theory.

It is clear that the final recommendation – avoiding research in one's own field – did not hold here. I am a practising physician who trained in the same institution as the participants, and continues to teach there. Indeed many grounded theory studies are undertaken by people in the same field as their employment (Thulesius *et al.* 2003, Scott 2009, Watling *et al.* 2016). As in the discussion on ethics, (Section 3.6.1) this is one of several practical barriers to a theoretically 'ideal' CGT. Nevertheless, by interviewing myself and using this as 'just more data' the impact of this on the issue of 'forcing' should be accounted for (Glaser 1998, p. 120). The constructivist critique of this is included in Section 3.5.2.

3.4.2 Coding Data and Constant Comparison

Data analysis in CGT involves 'coding' data to extract useful information from it. In CGT 'data' could be anything – interviews, surveys, statistical information, novels, newspapers etc. (Glaser and Strauss 1967). It often takes the form of qualitative data such as research interviews and text – this has led some to consider grounded theory to be a 'qualitative' method, but that was not the original intention.

Coding in CGT is based on a 'concept-indicator' model where *Incidents* in the data such as an observed behaviour, viewpoint or event are taken as instances of *Concepts* which describe what's happening at a level of abstraction away from the detail of the incident (Glaser 2002b). Initially the incidences are given tentative *Codes*. By continually comparing multiple incidents with the accumulating list of *Codes*, patterns begin to emerge. This *Constant Comparison* of *Incidents* and *Codes* continues as *Codes* are then compared to other *Codes* to look for *Concepts,* and then superordinate patterns or *Categories*. This is illustrated in the following example from this thesis.

In an early interview, a student described feeling embarrassment in front of colleagues:

> I have a terrible fear of looking like an idiot and just not knowing the answer, or… not being brave enough to actually say it, even if it's wrong [Interview 3]

This was initially coded as 'avoid looking stupid.' Other incidents were coded in a similar way e.g. when a student's colleague was too embarrassed to perform an examination in front of her:

> They didn't feel comfortable doing the examination. They felt they didn't know enough, so…maybe they wanted to just watch somebody else do it [interview 6]

There were times when the risk of embarrassment was possible, but not evident in practice:

> I never felt a lot of pressure like, oh gosh, I feel like an idiot and I know nothing, because there was always something that everyone sort of brought to the table, which was quite nice. [interview 4]

And examples where the concern was making patients upset:

> Like, I mean, [other students] can be a little stilted or not overtly inappropriate … but they may not be quite as tactful [interview 11]

It thus became clear that a pattern of social embarrassment was prominent in the data. This *Concept* of 'embarrassment' was compared with other similar codes such as 'avoid social awkwardness' and 'don't look too keen', 'don't upset the teacher' and eventually a *Category* was defined to cover all of these – *Social Risk*. The sub-concepts (embarrassment for oneself, for others) were taken to be 'properties' or facets of *Social Risk*.

How does one arrive at these codes? Glaser recommends close attention to every line of the data, and ask oneself at each stage three questions: 'what category does this incident indicate, what property of what category does this incident indicate? What is the participant's main concern?' (Glaser 1998, p. 140). 'Line-by-line' coding is contrasted with coding by overall impression: Glaser counsels against this lest we overlook key incidents (Glaser 1978, pp.

57–58). This also avoids prejudgment where researchers collect only data of interest to their preconceptions. During *Open Coding* in this study every line of the interview transcripts and other data was read and all potential incidents were coded.

3.4.3 The main concern and the core category

After much *Open Coding* (and *Constant Comparison*) the researcher will identify a 'main concern' – the social issue that appears to be most important in the data. Further coding should identify a '*Core Category'* – the concept that addresses the main concern. Some examples from the literature are given in Table 3-C.

Table 3-A - Examples of Main Concerns and Core-Categories

Study	Main Concern	Core Category
Scott, Online Learning (Scott 2009)	Finding the time to study	Temporal integration; different types of learners employ different strategies with varying success
Breckenridge PhD study of occupational therapy (Breckenridge 2010)	Being person-driven in a service-driven organisation	Revisioning – constant balancing of service ideals and client realities
Awareness of Dying (Glaser and Strauss 1965)	How to handle whether patients are aware they are dying in hospitals	Awareness contexts – settings and practices by which patient's awareness is managed

In this thesis the main concern related to decisions students make about taking part in peer learning (or not), and was eventually refined to how students 'get ahead in education while getting along with their peers.' The *Core Category* that evolved was initially considered to be a kind of threshold decision that help students choose *whether or not* to participate in peer

learning, but over time was refined and resolved to its final state – *'Internal Negotiation'* where students constantly balance the competing educational and social tensions.

3.4.4 Selective Coding

Once a *Core Category* is identified, one can start to focus only on incidents and concepts that relate to it: *Selective Coding*. This increases the efficiency of the process as we can now ignore incidents that do not seem to relate to the *Core Category*. For example, in this study incidents that did not seem relevant to decision making related to peer work were not coded. This included comments students made about the value of certain classroom procedures, concerns they had about the travel budget etc.

This would appear to put a lot of trust in the researcher to make accurate decisions. Glaser himself notes the arbitrary nature of such decisions but argues that the appropriateness of these decisions will even out in the eventual product. We should not worry about whether these decisions were 'correct' (Glaser 1998) but rather whether the product 'fits' the data. This is taken up further in the discussion of alternative approaches to grounded theory. The detailed description of the coding process above serves to demonstrate my understanding of method, and the quotations throughout the chapter provide evidence that it has been applied in a reasonable fashion.

3.4.5 Theoretical Sampling

A key question in any research project is how to select data. In typical scientific experiments this relates to sample size, randomness, issues of power calculation *etc.* In CGT this is resolved by predicating sampling decisions on the theory obtained so far: *Theoretical Sampling* (Glaser 1978, p. 36). While an initial sample must always be chosen (in this case medical students undertaking clinical placements in their fourth year of training), subsequent sampling depends on what the theory suggests would be a useful comparator group. Breckenridge discusses the way that grounded theorists ask 'where to sample next and for what theoretical purpose'

(Breckenridge 2009), and then collect data in that setting. This is not about testing the veracity of the theory but about getting useful information when emerging concepts are varied. For instance, in this thesis the concept of *Social Risk* suggested that identity and reputation were important; sampling peer learning where students could become anonymous (the 'Peerwise' online programme) was considered useful.

This process has limits which are often practical – accessing groups outside one's own institution can be difficult and impractical given the time constraints of most research projects (Breckenridge 2009). A researcher may decide it would be useful to sample a group of vulnerable adults, but the challenges in making a post-hoc change to ethical documents and safeguarding procedures might make this infeasible.

In this thesis these sampling challenges were overcome by a carefully justified ethical approval application and by using routinely collected data from other peer learning work in the institution. I leave open the option of sampling elsewhere in future work, for example to evaluate how variables such as *Social Risk* operate in other cultures.

A failure to theoretically sample a group has to be taken in context – yes it might miss a useful insight, but this does not make the current theory *wrong;* rather it recognises that further *modification* is likely as the theory is continuously refined (Glaser 1978, p. 5). This issue taken up again in the discussion of quality criteria in grounded theory.

3.4.6 Theoretical Memos

Throughout the above process the researcher writes frequent memoranda of what they think is happening in the data. They will define concepts, consider connections, reflect on how patterns fit together (Glaser 1978). These *Theoretical Memos* will form the basis of the final presentation of the theory. There is no set format; in early work Glaser suggests they should be free of close-editing in order to support the instinctive 'preconscious' nature of theory generation, but should ideally relate to one concept at a time to maintain

focus (Glaser 1978). CGT researchers describe these being anything in length from a few lines to several pages (Scott 2009). As the CGT work progresses these memos get increasingly sophisticated and relate more and more to the finished theory.

3.4.7 Theoretical Sorting

At a certain juncture the researcher considers that they can explain enough of the *Core Category* to start to structure the theory. In this crucial process called *Theoretical Sorting* the researcher tries to organise the memos according to where they seem to fit with one another (Glaser 1998). This sorting is how the theory starts to come together. Through the sorting process the researcher writes further memos *on the memos* as a way of connecting the abstracted concepts. This has the advantage of keeping the process manageable (the analysis of hundreds of codes is presented in dozens of memos), and importantly keeps the theory from becoming simply a description of events (Glaser 1998, p. 188). Piles of memos are placed on a large table and this physical sorting organises the ideas and suggests the form of the theory. The potential relations of the various memos and codes are integrated by Theoretical Codes, described next.

3.4.8 Theoretical Coding

Theoretical Coding is qualitatively different from the types of coding above. While *Open* and *Selective Coding* refer primarily to the analysis of incidents in the data, *Theoretical Coding* is a way of *integrating* the *Categories* into a working theory. It is based on the *Categories* and theoretical memos produced, not the source data itself (Glaser 2005, p. 11). This is important in order to maintain the level of abstraction implied in a theoretical model, and avoid what Glaser calls ‘conceptual description’ where effort is put into creatively describing and illustrating the detail of the data, while failing to provide a working model that provides hypotheses that could be tested elsewhere (Glaser 2005, p. 11). Without such integrating power, the risk is of ending up with a list of concepts that do not fit together in a useful way (Watling and Lingard 2012).

Theoretical Codes are understandings that 'model' the data (Glaser 2005). This is best illustrated with some examples. If the *Core Category* seems to relate to a change from one state to another, the theoretical code might be a *process*. If it relates to a threshold decision to be made – such as whether to resign from employment – it might be a *cutting point*; sometimes the important feature will be about classifying behaviours as in *typologies* (Scott 2009). In each case the *Theoretical Code* is a kind of metaphor for what is happening. CGT proponents have collated large tables of 'known *Theoretical Codes'* (Hernandez 2009). These can come from any field; biochemical theories may prove useful ways to model social behaviours; economic principles could be helpful in the modelling of group interactions *etc.* Glaser counsels CGT researchers to become familiar with such lists to increase the chance that they find a suitable one for the data under consideration. This is known as *Theoretical Sensitivity* (Glaser 1978). Without this range of tools, one might always try to see typologies, or consider all social interactions to be processes from one state to another (a phenomenon he calls 'pet codes').

In this thesis I read other grounded theories to familiarise myself with these codes. The final model I have chosen bears some resemblance to the 'balancing' described by Hans Thulesius in his work on goal setting in palliative care where practitioners balance multiple tensions like patients' needs and clinicians' resources (Thulesius *et al.* 2003). I also considered cycles, cutting points, the notion of hierarchy and other ideas. My core category of *Internal Negotiation* is therefore modelled on the *Theoretical Code* of 'balancing'.

3.4.9 Theoretical Saturation

When does one stop sampling? This is dealt with by the idea of *Theoretical Saturation* – the existing categories are considered unlikely to be meaningfully enlarged by further data collection. This is a researcher's judgement, and a 'good' grounded theory is *always* open to further modification (see Section 3.4.12 on quality), but a plausible limit to this is deemed to have been reached. Note that this is not the same as *data*

saturation where no new information is likely to be gleaned from further analysis (O'Reilly and Parker 2013). Sampling could go on indefinitely, but since the purpose of CGT is to develop a workable theory, the key feature that delimits the data collection is whether the researcher considers their theory to have problematic gaps, or has a relatively well integrated and 'dense' theory already.

In keeping with this, the number of interviews planned in this thesis was deliberately open ended. Initially 13 students from year 4 were interviewed, but as coding progressed the decision to sample some more senior students was made (the development of social relations over time seemed important to the *Categories* of *Social Reward* and *Social Risk)* and 3 more students from Year 6 were interviewed. With further coding it was considered useful to ask whether difference in apparent *Social Risk* was important in peer work, and anonymised comments related to a peer question-writing program PeerWise was sampled. At this point the data collection was paused to allow for *Theoretical Sorting.* Some further data was felt to be useful and so interviews were re-appraised and some categories revised to reach the current version of the theory. Further primary data collection could be justified but was not considered essential. Supplementary data from the literature was considered helpful, but in general the theory was well enough saturated to present in a useful way.

3.4.10 Writing up the Thesis

The sorting of theoretical memos should result in logically structured stacks of memos (Glaser 1998). These can then be written up as a working theory, and should be detailed enough to allow someone to follow the working.

As part of the CGT outlook, this should not be presented as a reconstruction of the coding process, but rather as presentation of the theory with *illustrations* from the data. This approach has levied charges of opacity where the reader is meant to take it 'on faith' that the data support the theory (Bryant 2003). This can be countered by the clear and annotated description

of method given above and appropriate illustration 'dosage' in the theory itself (Glaser 1998, p. 198). In this thesis I have attempted to present the theory clearly and succinctly with enough illustration to help the reader understand it, and provide reassurance that the data fit my model. I also trust that this 'methodology' section of the chapter has demonstrated enough insight into the process to reassure the reader that the CGT procedures have been followed with adequate rigour. This aims to strike a balance between efficient but unsupported pronouncements of theory and detailed but laborious descriptions of method.

3.4.11 The Role of the Literature Review

With the theory well established, it is now compared to existing work. The rationale for delaying this is to avoid prejudging which subjects will be most relevant to the theory. This could lead the researcher to try and 'force' a pet-theory on the data, which is contrary to the requirement for openness outlined above. Furthermore, it is argued that one cannot know what will be most relevant at the outset of the project – a whole seam of relevant literature could therefore be overlooked.

Once the literature review is performed, the nascent theory is compared to the existing literature and any necessary accommodations are made. This is important to link the theory to extant concepts which can themselves be critiqued. The way this is done in practice varies between researchers – Glaser suggests footnoting reference to the literature in theory presentation (Glaser 1978, p. 137) , but others write a section after their theory to demonstrate the links (Dunne 2011). I will do both with some references to the literature during the presentation of the theory itself, and a deeper study of relevant papers after that.

Still, this area is controversial: how does one know whether a grounded theory in the substantive area already exists? How do we justify the research to review bodies? These issues are addressed here as follows:

A limited literature review *was* done in application for this MD programme – this is common practice in grounded theory, and the practical necessity of this is acknowledged by grounded theorists in several traditions, though they handle it differently (Glaser 1998, Watling and Lingard 2012, Bryant 2017a). It is also recognised that research review panels and boards require a thorough literature review to ensure that the time of research participants and resources of research funders is not wasted (Dunne 2011). Moreover for publication, a grounded theory that does not add anything might be dismissed as non-contributory (Locke 2015).

In this work, the baseline review clarified that no grounded theory of this subject has been performed in medical education. While some potentially relevant theories such as the nature of competition and collaboration in learning were found, the self-interview process outlined above should account for their relevance (or not) to the final theory. Furthermore, my openness to new theory is attested by the discovery of important concepts I did not predict. Most notably, *Social Risk* was surprisingly prominent in discussions on peer learning and in the later literature review led to exploration of studies in 'psychological safety' not encountered in the baseline review. The *Core Category* itself – *Internal Negotiation* – bears little resemblance to any of the ideas encountered in the baseline literature survey.

This hybrid approach thus acknowledges the legitimate criticisms of the delayed literature review, and demonstrates the advantages of waiting until the theory has form before completing a full analysis.

3.4.12 Quality in Grounded Theory

In judging the quality of CGT, the main emphasis is on product – if the final theory fits the criteria in Table 3-B then it is of reasonable quality. Given the time Glaser has dedicated to presenting procedural issues, it also seems likely that process matters, but the implication is that the final theory is itself

some kind of guarantor that procedures have been followed. Other approaches to quality in grounded theory are considered later.

Table 3-B - Quality Criteria in Classic Grounded Theory

Fit the categories and codes must match the data under description
Work The theory must be able to explain what is happening, make relevant predictions and explanations
Relevance The theory is useful and relevant for the area under consideration – it is an important concern
Modifiability The theory is open to modification as new data are examined - it is never finished or 'correct' but always open to redefinition

3.5 Alternative Approaches to Grounded Theory

Having given a fairly detailed description of Classic Grounded Theory, I will now discuss some of the major alternative versions that have been developed. This will include justification of the decision to use Classic Grounded Theory.

3.5.1 Straussian Grounded Theory

Anselm Strauss was the co-author of the original grounded theory texts with Barney Glaser (Glaser and Strauss 1967). However, in later life he worked with Juliet Corbin to develop new procedures for carrying out grounded theory (Corbin and Strauss 1990). This included a framework for how coding should proceed and what kind of patterns to look for in the data. For example, Corbin and Strauss stress the importance of considering 'conditions, contexts, strategies and consequences' when trying to code data. They call this 'axial coding' and it seems somewhat similar to the *Theoretical Coding* listed above. They also require that researchers draw in 'broader structural conditions' like economics, social contexts, political pressures etc. (Corbin and Strauss 1990). By emphasising procedures like this, the intention was to make grounded theory procedures clearer and more accountable. However, this more structured approach met with significant criticism from Glaser, who felt that the open-ended nature of Classic Grounded Theory had been betrayed (Glaser 1992). He argued that such procedures limited the scope of a theory and committed the sin of 'forcing.'

3.5.2 Constructivist Grounded Theory

Many researchers have drawn on post-modern thinking to question the notion in both Classic Grounded Theory and Straussian Grounded Theory that the theorist can be neutral, have 'no preconceptions' or should be trying to limit their 'bias' (Bryant 2003, Charmaz 2006, Watling and Lingard 2012). They argue that everyone creates a shared social reality in an interpretive way, and thus it is impossible to separate the researcher's own perspective from that of the research participants, that terms such as bias and neutrality invoke an idea of an objective observer more in keeping with laboratory

science than social research. This tradition has practical implications for many aspects of grounded theory. For example, the role of the researcher moves from impartial observer seeking to explain the 'truth' of what's happening, or finding the 'core category', to the researcher collaborating with participants to co-create an account of their stories (Charmaz 2006, p. 10). The idea of 'no pre-conceptions' is seen as illogical since all meaning is continuously created through the interaction of the person and the social world around them (Charmaz 2000) and we always carry basic assumptions about language, cognition etc. Similarly, it is highly likely that a researcher will have some pre-existing experience in the area under question, and will already be steeped in the literature or pertinent ideas (Bryant 2017b). The desirability of a 'delayed literature review' is therefore called into question.

Constructivists are also sceptical of the idea that grounded theory can discover generalisable lessons that apply everywhere (Charmaz 2000, Watling and Lingard 2012), instead arguing that the theory is one of 'conceptual *hypotheses'* and the reader can make up their own mind about how transferrable these predictions are likely to be in their own context.

Finally, there are modifications to the quality criteria used for judging a theory. Constructivist approaches include the idea of Credibility (have procedures been followed?), Resonance (do the findings make sense to the research participants) and Usefulness (can they be applied by the people under study?); as Watling and Lingard state, one can 'appreciate considerable overlap' between these and the CGT criteria outlined above (Watling and Lingard 2012, p. 860).

3.5.3 Decision to use Classic Grounded Theory

The Straussian approach shares features with Classic Grounded Theory. However, I do find the recommendation that one always seeks to draw in, for example, political and economic trends somewhat artificial and impractical. While they *may* be pertinent to my area of research, how can one know that in advance? The significant advantage of grounded theory - giving primacy

to what appears in the data rather than pre-existing theory – seems to be diluted by an approach where the theory's structure is specified *a priori*. Furthermore, Corbin and Strauss suggest that their procedure can in fact provide some verification of their theory, being 'true for the phenomenon under study' (Corbin and Strauss 1990, p. 422); while I am satisfied that grounded theory provides plausible explanations of events, I think that other techniques would be better suited for their verification if that is the aim, perhaps with more experimental design.

The Constructivist approach is appealing. I am open to the idea that there is no objective truth and that notions of bias and neutrality may not be appropriate in social contexts. A recent book by Bryant has in fact invoked the name of pragmatism in a defence of a more Constructivist approach (Bryant 2017b). As part of my pragmatic perspective (see Chapter 1), my own background and goals have been described in the introduction. This should satisfy many of the requirements of Constructivists that researchers should declare their theoretical assumptions, interests and professional positions (Watling *et al.* 2012).

Nevertheless, I have chosen to conduct my research using Classic Grounded Theory because I find some of the positions taken in the Constructivist approach limiting. For example, there is little in the way of guidance about how to approach quantitative data from a Constructivist perspective in the key texts (Charmaz 2006) – in principle I am open to including any results that could help form a useful theory. Bryant (2017b, pp. 6–7) argues that Constructivist Grounded Theory does not preclude the use of quantitative data but does not provide much guidance. Glaser has written a book on the subject (Glaser 2008), and others in the CGT tradition have described their use of both qualitative and quantitative data (Walsh 2014).

Another challenge is the importance Constructivists attach to setting out one's own position – even proponents of Constructivism acknowledge 'that identifying and articulating all of one's preconceptions is not feasible' (Bryant 2017b, p. 150). There are many subtleties of our own thinking that we are

not aware of (Kahneman 2011): it is not clear we can be sure we have articulated the preconceptions that are most important in the 'shared construction' of the theory, or most useful for a reader.

Regarding the critique of Glaser's apparent objectivism, he clearly accepts that it is not possible to neutralise the researcher's role (hence the necessity for the injunctions outlined in section 3.4.1). If we view these as reasonable steps to emphasise what matters to participants whilst accounting for the researcher's position, the practical difference between this and a Constructivist perspective seems to blur. While the language in CGT speaks of researcher bias and implies an objective 'real world,' we need not take it to exclude any possibility of Constructivist views. In Glaser's later writing he is clear that a Constructivist perspective may turn out to be appropriate to the data under consideration, just that we should not assume this to be the case from the outset (Glaser 2005, pp. 127–139).

Ultimately, there is no consensus about which is the most appropriate approach, with debate continuing to the present day (Glaser 2002a, Bryant 2003, Walsh *et al.* 2015a), though there may be some move towards détente. Walsh and colleagues talk of a tentative consensus between a caricature of positivism and a caricature of relativism.(Walsh *et al.* 2015b), and the conclusions of Bryant's writings on Pragmatism are similarly open minded (Bryant 2017a).

I am therefore using the CGT approach in accordance with my view of Pragmatism – holding no fundamental and irrevocable belief about which is the best approach – and can justify its use in that it remains well established in the literature and seems likely to provide helpful insights for educators. Alternative approaches would be reasonable but not necessarily better for this purpose.

3.6 Research Context, Participants and data collection

Having reviewed the CGT method, I will now describe how data were collected.

This study took place in Edinburgh University in the spring of 2017. The medical school has been described in the introduction to this thesis but the key points for this chapter are that:

- Peer learning is already practised in an informal way, with many students preparing for assessment in groups and taking part in between-year peer learning projects (Young *et al.* 2014)
- The initial sample, Year 4 of the 6 year programme – included students learning in the clinical workplace, so was relevant to the overarching interest in clinical competence in the clinical setting.
- Recruitment was initially open ended with no predefined cohort characteristics or minimum number of interviews set.
- A subsequent sample came from Year 6 students to explore the putative effects of relationship building

Data collection took place through the use of research interviews (Watling and Lingard 2012). In keeping with our ethical considerations our general question topics were specified at the outset (to avoid harm by asking unwarranted questions about sensitive issues). Nevertheless these were open enough that they avoided assuming what mattered most to students, and as the interviews progressed these areas were refined to follow the nascent theory. Interviews – approximately 1 hour in length - were recorded and transcribed then analysed using Classic Grounded Theory methodology.

Again I should note that the interviews were the same as those used in Chapter 2. Here, however, the analysis of that data followed GT principles and the sampling decisions were guided by the notions of theoretical sampling outlined above. Some cohort characteristics (gender and international/UK student status) are outlined in Chapter 2's introduction, but

in keeping with CGT principles, demonstrating a 'representative spread' or 'study homogeneity' are not the key factors that should guide data collection. This has already been discussed in the section on theoretical sampling. Note that cohort characteristics (e.g. gender) earn their way into a CGT report in the same way as any other code: *if* they influence behaviour they are in the model itself (Glaser 1998, p. 139).As the theory took shape, a third sample came from the anonymously and routinely collected comments left by Edinburgh medical students on the Peerwise programme (Denny *et al.* 2008). This is a programme that encourages students to write formative assessment questions for one another in the early years. Students can comment on and discuss one another's questions. Students cannot see one another's identity – this sample thus provided a contrasting dataset in that it could explore the effect of anonymity on peer-peer interaction, and the effect of new or absent interpersonal relationships between students. The comments by students were treated as more data for coding and comparison.

3.6.1 Ethical issues

One thing not covered in the CGT methodology is the appropriate approach to ensuring ethical concerns are met throughout the research process. In this study there are several issues relating to the founding principles of medical ethics – autonomy, beneficence (and non-maleficence) and justice (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979):

3.6.1.1 Preventing Harm (non-maleficence)

Harm to participants in this study could have come from several sources. Students who volunteered for interview could suffer if the discussion involved unexpectedly upsetting content such as experiences of unprofessional behaviour from other students or untoward events with patients. They may also have been concerned about threat to their reputation whilst speaking to me, a medical school employee. Due to the open-ended nature of interviews, these risks are never negligible. They were reduced by ensuring that

- I undertook training prior to interviews (by D Hope, thesis supervisor),
- Interview topics were chosen to avoid deliberate discussion of sensitive issues not pertinent to the research aims
- I agreed to avoid future assessment of interviewees in any future summative assessments with a major 'subjective' element such as viva examinations
- Confidentiality and Data Protection guidelines were followed strictly (see below)
- Clear provisions were made for follow up support from myself or if preferred external advisers and counselling staff

Confidentiality is a related concept to preventing harm, and includes the careful protection of data. All interviews were recorded in private interview rooms, all information was recorded securely and stored on encrypted and password protected computer files in line with my data policy (Appendix 2), and all paper consent forms were stored in locked offices. All recordings were made anonymous by a numbering system (with look-up list also password protected and accessible only by me). Transcripts were completed by secure, password protected, University approved secretarial services and references to named individuals removed manually. All quotations were given pseudonyms and content trimmed to reduce the chance that anyone could match the statement to the interviewee in publication.

Another question here is whether this research is wasting the time of students or the medical school generally. The justification for a grounded theory of peer learning is given above, and I note also that the baseline literature review confirmed that such a project had not already been done.

3.6.1.2 Autonomy

Autonomy here deals most specifically with adequate free and informed consent. Recruitment took place on online notice boards or in person after scheduled teaching sessions (students were free to go after the sessions). There was no financial reward for participation. Recruitment was timed so that it was at least 2 weeks from all summative assessment. Information

about the interviews and a copy of the consent form was given to all participants in advance of the meetings. Participants could withdraw consent, with the caveat that both publication and analytic integration of the data from their interview would limit this.

3.6.1.3 Justice

Justice is about the concern for the wider community. One consideration for this project was that the current blanket approach to peer learning – it is universally good or it is universally bad – misses the potential for differential effects for individual students. For example, if peer learning *is* helpful, it would be unjust if some students were able to access it and others were not. A theory of peer learning at medical school could reveal these barriers and so be seen to promote fairness. Nevertheless, research participants may be self-selecting empowered students already, so the degree to which 'disengaged' students are represented must be considered.

3.6.1.4 Beneficence

The intention was that this project would benefit education at this institution by providing a better understanding of the advantages and limitations of peer learning. This could even influence the learning of the participants themselves, if insights affected their future training. This and the advantage for others reading the research provides the main justification for the ethical risks mentioned above.

3.6.1.5 Ethical approval

This was approved by the University of Edinburgh College of Medicine and Veterinary Medicine Student Ethics Committee. The complete proposal with amendments is included in Appendix 1.

3.6.2 Summary of method

The preceding sections have defended the choice of CGT and set out its main components. It has described the research process – decisions about data collection and the use of ethical principles to guide research design. I now move on to the results of this research - the theory itself.

3.7 A Grounded Theory of Internal Negotiation

Here I will set out the theory itself. I will present an overview of the theory, followed by a detailed review of its key components and finally some examples of predicted outcomes the theory explains.

3.7.1 Notes on style:

This theory is written in declarative style – the grammar of hypothesis. While these sound like facts they are in fact all contingent on future testing (Glaser 1978, p. 129).

The main categories are in *Italics* with capitalised first letters e.g. *Internal Negotiation* or *Competition Context*. To avoid burdening with too many concepts, other codes are not marked separately e.g. embarrassment (a part of *Social Risk*) is not highlighted.

3.7.2 Overview of the theory

In order to orient readers to the theory, I will give an 'executive summary' which gives the main components of the theory and how they interact. It uses the new coding terms I have developed which are summarised in Table 3-C. These terms will be clarified in the more detailed description of the theory that follows.

The main concern of students in peer learning in the clinical context can be summarised as 'getting ahead while getting along.' The issue is about developing academically whilst also attending to social expectations. The key to resolving this is the balancing process of *Internal Negotiation*.

When an *Opportunity* for peer learning arises, a decision is made about whether to take part;. *Internal Negotiation* is the necessary balancing of potentially contradictory social and educational pressures to determine behaviour in peer learning. If they are correctly aligned a *Threshold* is crossed and the peer learning begins. The pressures – *Expected Educational Gain* of participation, *Social Risk* involved, and *Social Reward* – dictate the terms and outcome of the *Internal Negotiation* ranging from full

engagement through minimal engagement, non-engagement and even adverse competitive behaviour.

The ‘pressures’ are sub-core categories of *Internal Negotiation*. In *Expected Educational Gain*, the potential learning gain is estimated based on prior similar experience, judgements of the *Authenticity* of the event and its *Efficiency*. Favourable alignment of these factors calibrates *Expected Educational Gain* towards taking part in peer learning. In *Social Risk*, assessment of the threat to one’s own reputation or those of patients and colleagues is determined by relationships, confidence and prior experience. Unfavourable alignment of these calibrates *away* from engagement. *Social Reward* is the degree to which students get personal social benefit, and value the progress of their peers. It is dependent on *Competition Context* and *Social Grouping*. Hidden *Competition* and open *Social Grouping* calibrates in favour of peer learning.

These main categories are summarised in Table 3-C and Figure 3-c on the next page.

Table 3-C - Main Categories

Category Name	Brief Description
Internal Negotiation **(Core Category)**	The active balancing of competing tensions in a peer learning encounter. The balance of social and educational pressure determines the outcome. The pressures are Expected Educational Gain, Social Risk and Social Reward
Expected Educational Gain	The judgement of how likely the encounter is to help the student achieve educational aims
Social Risk	The concern for exposing oneself or others to social harm, embarrassment or reputational damage
Social Reward	The concern for building relationships and helping others reach their goals

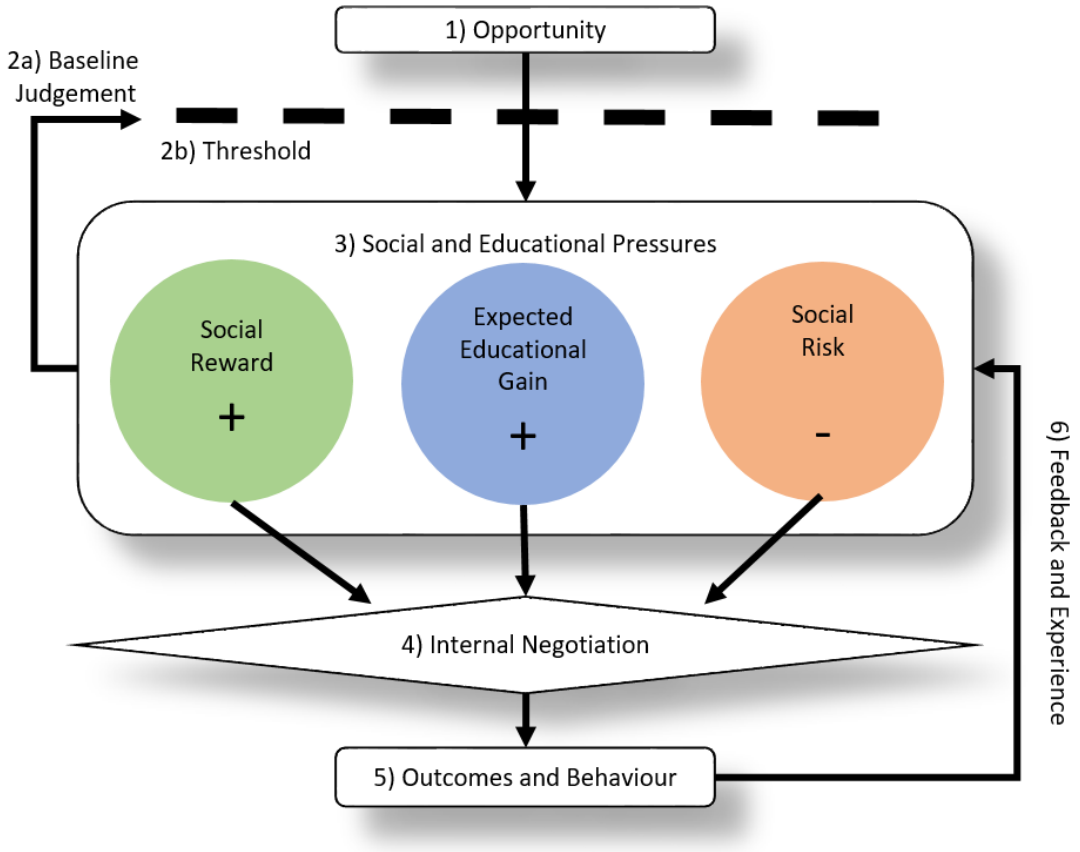


Figure 3-c Simplified Overview of the Theory

3.7.2.1 Illustrated Example

Before I look at the theory in greater detail, it may help to have an example of how it can explain behaviour using Figure 3-c as a reference point.

1) An *Opportunity* arises for a student and her colleague to participate in peer learning by taking a clinical history together (talking to a patient about their condition).

2a) The student makes a baseline *prima facie* judgement based on past experience of the educational and social pressures: while she is nervous – there is a concern about *Social Risk* – the proposed activity is deemed very likely to help with her goal of becoming a physician: the *Expected Educational Gain* is high. She has also worked with her partner before and so feels there will be some *Social Reward* for taking part.

2b) Thus the *Threshold* is crossed and peer learning begins.

3) The three pressures *Expected Educational Gain, Social Reward* and

Social Risk exert either positive (+) or negative (-) influence on the willingness to engage with peer learning

4) These forces are balanced by a process of *Internal Negotiation* which integrates the pressures and determines their relative influence on behaviour. Note that the Threshold (2a and b) is an aspect of this, but comes first chronologically so is detailed separately (see Section 3.7)

5) The outcome of this balancing is expressed in behaviours. For example the effect of *Expected Educational Gain* is expressed in a process of reciprocal critique of the partner's performance in physical examination. However, the effects of *Social Risk* restrict the students to 'easy' comments such as pointing out trivial errors: this avoids the appearance of being unkind. *Social Reward* promotes ongoing peer learning by agreeing to let her partner have a second attempt.

6) Continuous feedback to the ongoing *Internal Negotiation* (4) modifies the strength of the various pressures (3). For example as the encounter has gone well, the perceived *Social Risk* is less and the student is able to give more 'constructive' feedback without fear of causing embarrassment. The students agree to work together again.

The next section will examine the major components of the theory – *Internal Negotiation, Expected Educational Gain*, *Social Risk* and *Social Reward* in greater detail.

3.7.3 Internal Negotiation – the core category

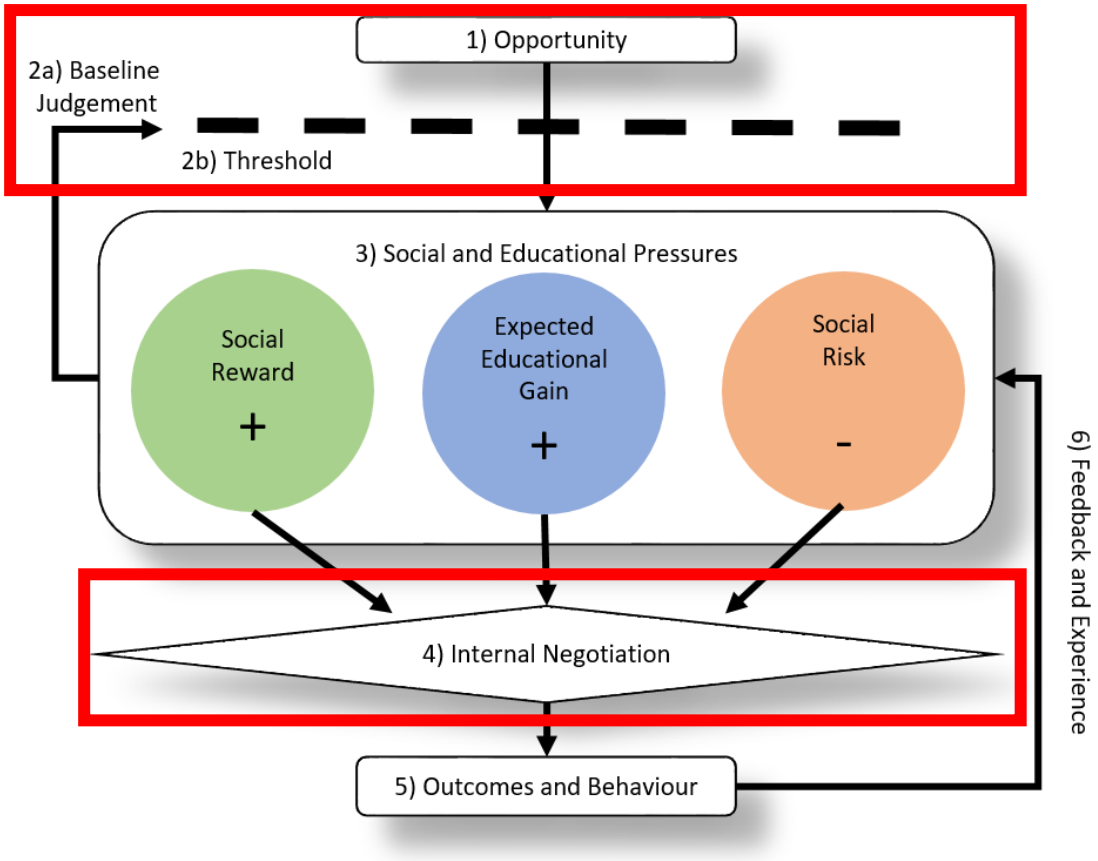


Figure 3-d Internal Negotiation - Key Features Highlighted

Conflicting educational and social pressures must be continuously balanced by *Internal Negotiation*; the outcome of this determines behaviours in peer learning. The educational and social pressures – *Expected Educational Gain*, *Social Risk* and *Social Reward* – will mostly be considered in subsequent sections, but here I will expand on the way the *Internal Negotiation* itself happens.

First there is the *Threshold* aspect – should peer learning begin at all? Second there is the *Temporal* aspect – how experiences and history influence the *Internal Negotiation* as it proceeds. Thirdly there is the *Skill* aspect: increasing ability in *Internal Negotiation* makes the balancing of pressures easier and increases the likelihood of positive outcomes. These properties will be discussed with illustrations to help clarify the concepts.

3.7.3.1 *Thresholds* and *Opportunities*

Internal Negotiation has a prerequisite: *Opportunity*, defined as a chance to engage in peer learning. Whether or not the *Opportunity* is taken in turn depends on the crossing of a *Threshold.* When the conditions of the *Opportunity* are favourable, the *Threshold* is crossed and peer learning with *Internal Negotiation* begins.

Opportunities include scheduled peer learning events, unplanned meetings with another student, a potential gap in the timetable, self-study time and so on. When *Opportunities* are convenient – they are routine, part of clear schedules, involve a familiar task and involve little physical effort - it is much more likely that *Internal Negotiation* will take place. For example, serendipity means there is little physical effort in engaging with peer learning:

> When you're on the ward you'll speak to the patients and I guess if there was another student there we might say would you like to go together and we can speak to this patient. [interview 10]

This convenience is important: while *Internal Negotiation* itself is a deliberate balancing of various factors, the *Opportunity* to engage in peer learning in clinical environments can be almost accidental. Similarly, when students are familiar with the task at hand it is clear what the opportunity will involve: the effort involved in formulating a learning activity is less. Scheduled peer encounters and other structural incentives also promote the convenience effect and make it easier to cross the *Threshold* of *Internal Negotiation*. This may include a feeling of being integrated into a clinical team where it is expected and routine that students will see patients. Conversely, when the availability of peers is low and requires some effort to attain, opportunities are not taken:

> Even the responsibility of finding a friend might just be enough to tip you against going [to the wards] [interview 13]

Even when these factors are favourable, the crossing of the *Threshold* still depends on a *prima facie* assessment of the educational and social pressures that will be detailed later. This is based on past experience. Where the balance is sufficient to proceed the *Threshold* is crossed and *Internal Negotiation* can continue. For example, when *Expected Educational Gain* is high opportunities are more likely to be taken:

> When it comes to more practical sort of skills … I would do that with other people because if you're taking a history one of you can sort of pretend to be the patient and do a bit of role play… [interview 10]

But when the balance of pressures does not favour beginning peer learning, the result is disengagement, as in the concern that the *Social Risk* of embarrassment is too high:

> I find that if I'm studying with friends and they are talking about things I haven't heard about, I sort of let myself spiral in anxiety. [Interview 4]

Social Risk is also active at this stage in terms of how welcome students feel in a clinical environment. It carries *Social Risk* to approach busy clinicians for help, and this is reduced when students feel more welcome on a ward.

> When we were with [one doctor] over in [a local hospital], it was just that you felt more part of the team. …There, you know the registrars and nurses and you just learn more and were more confident to ask things [interview 3]

To summarise the importance of *Thresholds* and *Opportunities*, whether *peer learning* will begin depends on the character of the opportunity – convenient and routine *versus* arduous and unfamiliar - and the *prima facie* assessment of *Internal Negotiation's* educational and social pressures – apparently useful, safe and rewarding *versus* risky and of doubtful benefit. I next consider what happens during peer learning events as *Internal Negotiation* continues.

3.7.3.2 Internal Negotiation

Internal Negotiation was defined as 'The active balancing of competing tensions in a peer learning encounter' (Table 3-C). Once the *Threshold* is crossed, the *Temporal* aspect of *Internal Negotiation* becomes clear – decisions change moment to moment as at each decision a social or educational pressure takes pre-eminence. In any decision trade-offs are made between *Expected Educational Gain*, *Social Risk* and *Social Reward*, and the pressure which is most prominent will dictate the current decision. Response to that decision will influence the next decision and so on. *Internal Negotiation* therefore has an iterative character as each decision recalibrates another. For example, when *Social Risk* is dominant the possible *Social Reward* and *Educational Gain* recede, resulting in muted interactions:

> If your first negative comment as it were wasn't met terribly openly, I suppose, in that sense you can kind of judge how receptive they would be and giving further negative feedback is actually just going to worsen your relationship and they're not going to take in anyway [Interview 14]

When the encounter appears to involve little *Social Risk* – it is not awkward or embarrassing – further risks can be taken and the encounter is more productive. This also demonstrates the context-specific nature; students are constantly re-balancing these pressures depending on the behaviour of the specific partner, the influence of patients etc. Similar examples of when *Expected Educational Gain* and *Social Reward* are more dominant will be given in the discussion of these concepts below.

Internal Negotiation is also cyclical - it varies with repeated interactions and the accumulation of experience across multiple events. Positive cycles occur when the *Internal Negotiation* yields experience favourable to engagement with peer learning –the *Expected Educational Gain* increases as a repertoire of helpful encounters strengthens this pressure; *Social Ris*k decreases as a relationship builds to accommodate risk-taking; *Social Reward* increases as

the success of others becomes increasingly valued. Thus the development of relationships both allows and promotes good peer learning in a kind of virtuous cycle.

This is well illustrated in 'friendship-study' cycles, where groups of students develop long-term study groups of well-aligned peers

> In that group these are all my best friends, these are people I've known very well since first year and we've been doing that since first year, so we're all very comfortable with how we used to quiz each other in that sense. …whereas I wouldn't have been comfortable doing that with people I didn't know at that time. [interview 15]

Negative cycling represents an accumulation of awkward experiences, where embarrassment, lack of educational benefit and an alienation of social bonds accumulate in disengagement with the process

> [Some people] who are of a certain personality type will get ostracised by the group, which affects their learning, and it affects our learning. …because no one wants to be in a group with them, or they don't want to offer their opinions if they're gonna get shot down [interview 5]

3.7.3.3 Skill at Internal Negotiation

Internal Negotiation is difficult, but learning how to balance the pressures better increases the chances of a favourable behavioural outcome. Experience is a main predictor – having multiple opportunities over time to take part in peer learning it becomes easier even when the pressures appear contradictory. This skill is reflected in external behaviours, but represents the increasing ability to hold one (negative) pressure at bay while promoting other (positive pressures). Thus if the pressure of *Social Risk* is too high, novices are less likely to engage in feedback for fear of causing offence resulting in avoidant behaviour:

> I suppose for yourself you are not so used to giving negative feedback. I think before you started, before

> medical school, you don't really give people negative feedback, I don't think, in your day to day life. So I think not being able to have done that before makes it difficult for you to even start [interview 14]

At low levels of skill, the behavioural outcome is simply to avoid negative criticism. As experience or aptitude increases, strategies can be found to moderate the effect of *Social Risk.* The pressure is still there but it is easier to manage it with techniques such as altering linguistic delivery of criticism.

> Like, it's phrasing things and how to make suggestions to make changes that…without causing offence because I think people get very…if they feel they're being judged by other peers, they get very anxious and they get maybe a bit standoffish [interview 6].

Humour is another good example, as in this illustration of owning up to an error in a clinical matter:

> ====> Reply 1: Hang on, you're right... my bad. Plz send help ; [PeerWise comment]

This kind of skill can also be encouraged by external cultural factors, such as the development of a programme where feedback (and techniques to control *Social Risk)* are commonplace.

> I have so many feedback forms but in a way it's actually quite good in creating a feedback culture because when we have feedback sessions and things students or people from Edinburgh Medical School they are able to actually give quite good feedback. [Interview 14]

In other words increased *Skill* at balancing helps moderate the *Social Risk* and promote *Social Reward* and *Expected Educational Gain*.

3.7.3.4 *Internal Negotiation* - Summary

To summarise, during the *Internal Negotiation* process, there is a continual readjustment of behaviour based on the balancing of these pressures. This adjustment takes place moment to moment but also across several

interactions over time. This can have amplifying or inhibiting effects on peer learning depending on the outcomes of individual interactions. With increased skill and experience, it becomes easier to manage the contradictory risks and find more positive outcomes, for example by finding ways to promote *Expected Educational Gain* and *Social Reward* without incurring undue *Social Risk*.

3.7.4 Expected Educational Gain

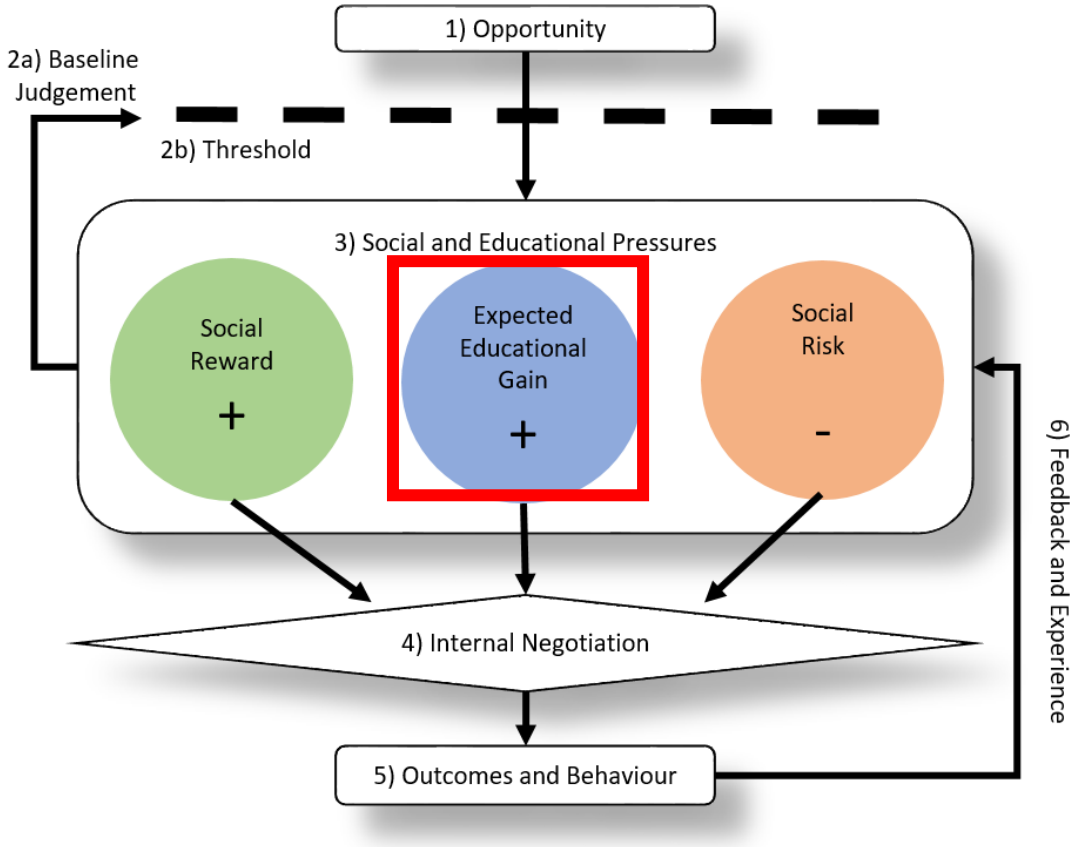


Figure 3-e Expected Educational Gain - Key Feature Highlighted

Expected Educational Gain tends to promote positive educational experiences in peer learning. Here I discuss what contributes to *Expected Educational Gain* and give greater detail about how this works in practice.

The higher the *Expected Educational Gain* of a peer learning encounter, the more likely the *Threshold* of *Internal Negotiation* will be crossed and the more behaviour during *Internal Negotiation* will be directed at promoting learning. *Expected Educational Gain* is a judgement about how beneficial the event is likely to be toward their educational goals – such as clinical skill, knowledge, performance in summative assessment etc. (the range of such goals was outlined in Chapter 2). It is not necessarily an accurate judgement of actual educational gain, but is nevertheless an important predictor of student behaviour. Again there are several features of *Expected Educational Gain* that explain its effect; the judgement of *Authenticity,* the judgement of

Credibility; the judgement of *Efficiency*. I will also discuss some extreme examples of *Expected Educational Gain* – both positive and negative – to illustrate its impact on peer learning.

3.7.4.1 Authenticity

Expected Educational Gain is higher when the activity is considered to be *Authentic*. *Authentic* activities resonate strongly with personal goals because the form or content seems appropriate. For example, if the goal is to gain practical competence in clinical skills, peer learning may be considered *Authentic* because its physical and interactive nature aligns closely with the goal:

> so either clinical skills or just sort of your histories and examinations, partly I would do that with other people because if you're taking a history one of you can sort of pretend to be the patient and do a bit of role play but at the same time… So if it's sort of trying to get a knowledge base on something I think self-learning is good, whereas if you're trying to do something that's very practical or even just history taking it's good to get feedback…[interview 10]

There is thus a strong consonance between the goal – learning practical skills – and the proposed peer learning activity. This consonance has many roots – peer work promotes the team-working skills of doctors; the vicarious nature of seeing peers do practical activities and learning from observed successes and failures is immediately apparent; there is a chance to receive direct feedback practise giving feedback oneself *etc*. This list can be expanded significantly, but the key theoretical concept is that there is something synergistic or complementary in peer work: the expected learning from the activity is enhanced by having a peer present.

This is also helpful in explaining an interesting feature of *Social Risk* – while its general effect inhibits engagement with peer learning, a small degree of *Risk* is seen to be *Authentic* regarding 'real' clinical practice or performance in summative assessment where the possibility of damage to one's social or

professional reputation is always there. In this quote the student contrasts informal practise at home with seeing real patients:

> Again, I feel like it doesn't give you quite the same experience because you're not as nervous because you know the person. [Interview 7]

I should also note that if the proposed activity relates to a goal the student does not value, *Authenticity* (and *Expected Educational Gain*) is automatically less. This explains the way that some activities are considered to be 'burdensome obligations', a phenomenon where an activity that could be considered helpful - a tutorial or similar – is somehow tainted by the notion that it is not really geared towards reaching a student's goal. The stated purpose of group tutorials may be to learn about medicine, but the assumption that a (cynical) student makes is that there is some ulterior motive such as satisfying regulators' requirements for 'tick-boxing'.

> I think if you're attached to something that is unuseful that is compulsory it makes you feel that people are wasting your time. [interview 2]

3.7.4.2 Credibility

The synergy between goal and activity is tempered by the fit between peers, notably in understanding of the subject: where one peer is being taught by another who is less knowledgeable, the *Expected Educational Gain* is less[1]. This can be summarised by the concept of *Credibility*: whether the peer is considered a credible source of learning. *Credibility* increases with increasing expertise of the peer; a peer who is considered knowledgeable and competent is considered more credible where the teaching from a 'bumbler' is likely to be ignored. *Credibility* also increases with the objectivity of the critique: it is easiest when there are clear and unambiguous standards such as technical steps in a physical process, but more challenging when

[1] This challenges the notion that 'peers' are at the same level by virtue of being in the same year. I will return to this in the discussion.

there are high-level skills or attitudes in question. Subjective judgement from a peer is less tolerated: should the blind lead the blind?

> [Your peers] read different things or seem to have a different viewpoint and…like, so who comes to the conclusion in a group setting with no clinical staff what the correct answer is. None of us are a hundred per cent convinced, 'cause we've all got different information, we've got different sources. So how do we know what's actually done on the wards? [interview 6]

Without *Credibility* the peer learning activity loses *Authenticity*. This authority can be gained – for example when the standards are clear and unambiguous, or in more experienced students who become better at knowing the standard:

> But as all of us gained enough knowledge to be able to think, to be able to contribute, you start realising what you miss out in your plans. [interview 15]

3.7.4.3 Efficiency

Even a highly *Authentic* activity may still suffer in *Expected Educational Gain* if it is seen as wasteful of resource such as time and effort. This judgement is highly context specific, depending on the individuals present, the place the activity is taking place etc. It thus captures the way that the same activity – such as seeing a patient with a colleague – will be considered of high *Educational Gain* with one partner, but low with another.

> If you have a group which does not care and you're someone who does care who's sitting there thinking, well, I've put in hours of work on this and you've put in five minutes. You've copied something off Wikipedia and now you're forcing me to sit and listen to this, it's a bit disrespectful to colleagues. So, yeah, I think apart from that I would say it would be a waste of time [Interview 15]

This interest in finding efficient groups to work in is one of the factors that leads to the friendship-study cycles mentioned above; 'efficient' and 'useful'

partners increased the *Expected Educational Gain*. Moreover the time taken to undertake the activity is critical. This can incorporate a feeling that time is 'lost' to social interactions, or that time spent waiting on a ward in order to locate patients or get assistance from staff is better spent elsewhere:

> The concentration of learning opportunities is so low that it's barely worth you turning up, especially considering when nurses don't really want you there anyway and doctors don't really want you there anyway [Interview 9]

If there is too much administrative burden this also reduces the efficiency of the activity.

3.7.4.4 Cyclical nature of *Expected Educational Gain*

Again the *Expected Educational Gain* depends on moment to moment decisions and past history. Note that we can now describe positive cycling in terms of *Credibility* (working with peers known to be at a similar level, to be good at giving feedback etc.) and *Efficiency* (this is an easy and time-effective way to learn). It also makes *Authenticity* judgements more informed as one builds a better picture of the strengths and weaknesses of any one learning approach in relation to goals.

3.7.4.5 Negative *Expected Educational* gain

At one extreme of *Expected Educational Gain* is the notion of negative gain. This is not the same as having high *Social Risk* where participation will lead to embarrassment. It is the notion that the peer learning activity is in fact antithetical to reaching one's goals. This appears to be rare but is evident in extreme competitive behaviour leading to active avoidance of peer learning, or even reports of 'sabotage'…

> You get the odd person that'll…that's a bit cutthroat and wants to do this and won't tell you that this person's got good signs [interview 8]

In theory this could be overcome by extremely high *Social Reward* (strong friendship gains or group bonds) though the coexistence of such apparently opposite sentiments seems unlikely.

3.7.4.6 Summary of Expected Educational Gain

Students thus make a judgement of any activity's *Expected Educational Gain* based on its *Authenticity*, or consonance with their goals; its *Credibility*, or the ability of the partner to provide useful learning; its *Efficiency*, or what the time, administrative or other burdens are. This is constantly updated during an activity, but depends on prior experience of working in similar situations with similar participants. The general effect of high *Expected Educational Gain* is to promote engagement with peer learning.

3.7.5 Social Risk

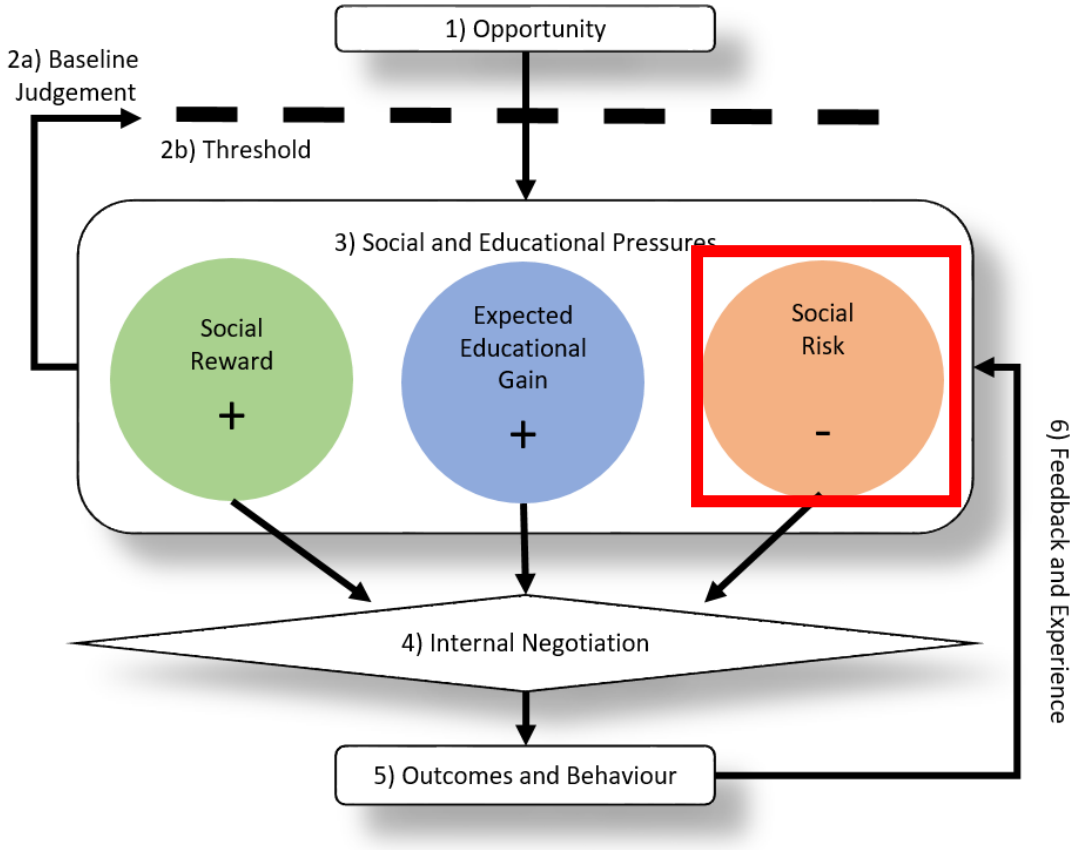


Figure 3-f Social Risk - Key Feature Highlighted

Social Risk is the perception that participation in peer learning presents a threat to the student's reputation or self-image through embarrassment, awkwardness, or causing this harm in others. When the *Social Risk* is high it inhibits the active participation in peer learning events and can have negative consequences for the student through shame, anxiety and stress. Its general effect is to make it less likely that peer learning will happen, and to limit the scope of the interaction when it occurs. *Social Risk* represents the *possibility* of harm, not harm itself. *Social Risk* again has properties that bear further examination: the self/other dichotomy; its relation with confidence; its interaction with *Authenticity*; its cyclical nature; its interaction with *Social Reward*.

3.7.5.1 Risk to Self and Risk to Others

One clear dichotomy in *Social Risk* is whether the risk is to oneself or others. In risk to oneself, the concern is about exposing one's own weaknesses or deficiencies, threatening a personal view of competence, or indeed appearing too eager. The nature of peer learning is critical here – the continuous comparisons that students make with one another are a way of judging performance and success, but also exposing deficiency. The key concern is that the proposed peer interaction will threaten the student's reputation or make them 'feel stupid': this threat is constantly modifying behaviours in order to avoid harm. This personal risk can be illustrated by examples of avoidance behaviour based on concern for looking too enthusiastic about learning

> …some students tend to be a lot more willing and enthusiastic than others and I think when I was with students who were more tired and just wanted to go home I would skip through some parts of the examination so that we can just get it done with and then go home [interview 16]

Avoidance can also be achieved through anonymity – complete disengagement with peers keeps a low profile and avoids all conceivable risk.

The risk of harm to *others* is different: here the concern is of causing another person social difficulties through, for example, condescending behaviour. This may overlap with a *Social Risk* to oneself (e.g. 'don't develop a reputation for being overbearing') but crucially others are at risk too. Examples of this include making patients or clinical staff feel uncomfortable, or upsetting patients involved in the encounter

> I've [examined a patient] once with somebody and they hadn't done it at all and you were teaching the other student as well as trying to do the exam. And I guess you're learning then as well, but you're trying to talk to a patient and the other person in the…behind the curtain. So I feel…I felt a bit rude to the patient when I was doing it [interview 6]

With peers this takes the form of not causing embarrassment through overenthusiastic critique, or demonstrating deficiencies in the other student's knowledge. Nevertheless the effect is similar; a concern of being a burden to patients or a source of awkwardness for a peer limits the engagement with peer learning.

This self/other dichotomy also explains the paradox of competition: students want to 'win', but not 'beat others':

> I'm quite a competitive person, so I do get stressed when I see people, other people doing things that I haven't done. But I wouldn't say I'm competitive because I want to beat them, I just think 'Oh god, should I be doing that as well?' Like, for me, yeah, [interview 1]

The desire not to lose out (as part of personal *Social Risk*) is therefore balanced by a desire not to harm others (as part of *Social Risk* to others).

3.7.5.2 The role of *Confidence*

As *Confidence* increases, the personal *Social Risk* reduces. Thus confident students are more likely to be willing to take risks in peer learning such as practising with people they do not know and being receptive to critique. This may be linked to the notion of 'self-efficacy' and will be taken up again in the literature review.

The risk of *causing* harm in others does not show such a clear pattern: confident students may still be concerned about exposing others to *Social Risk* as in offering personal critique. Indeed they may be even more worried about embarrassing another through demonstrating how far behind they are.

3.7.5.3 Cyclical aspects of Social Risk

Social Risk also modifies over time. This happens in the moment-to-moment interactions outlined in section 3.7.3.2, but also in iterative cycles, and longitudinally. The broad effect is that *Social Risk* reduces as relationships with other students build. As students get to know one another's characters,

competence, and develop a shared understanding of standards, this tends to reduce *Risk*;

> Especially in the final year we can be quite candid with the feedback, like the positives and negatives and then you can even… I think you can go into quite a great deal of depth because I think you realise that when you give negative feedback it's not because it's a criticism but it's more because you actually want to help that person be better [interview 14]

Thus relatively senior students with a clear idea of competence and history of working with their colleagues routinely are less concerned about this embarrassment than novices working together for the first time

In the genuine building of relationships a degree of trust builds, seen in the virtuous friendship-study cycles. These study groups are 'safe' so that willingness to expose oneself and others to *Social Risk* is increased. The longitudinal nature of these interactions is crucial – not only does it allow for risk taking, but the effects of a social harm are mitigated by the opportunity for future redemption: the stakes of any one interaction are thus reduced.

Negative cycles can also arise particularly during bad experiences or when an untoward event results in avoidance behaviour – the phenomenon of 'once bitten twice shy' – and it emphasises that building relationships can have negative as well as positive effects.

3.7.5.4 Reducing *Social Risk* by legitimising learning

Further mitigation of *Social Risk* can be achieved through the legitimisation of learning – the interaction is routine, expected, the environment is welcoming and standards are clear. The value of clear standards is that it provides a legitimate comment, even if this is minor, but in the building of safe critique it is a valuable first step.

> We weren't going in blind and saying I think that's wrong but actually, no, this is a marked scheme that we found and you need to actually introduce yourself. You

> need to wash your hands at the end as well as the beginning... [interview 16]

This also happens when role models or senior figures make it clear that critique and risk taking are expected.

3.7.5.5 Interaction with *Authenticity*

As outlined in the section on *Authenticity, Social Risk* does not uniformly inhibit learning (see Section 3.7.4.1).

3.7.5.6 Interaction with *Social Reward*

In the following section on *Social Reward* I will describe the notion of *Competition Context.* When it is clear that competition between students is high – as in some summative assessments - *Social Risk* is increased. These 'high stakes' settings magnify the consequences of error and reputational damage.

On the other hand, when students have a generally high sense of *Social Reward* because they have built good relations with many students and consider them all to be part of the same *Social Group* this reduces the *Social Risk* – everyone is 'on the same side.'

3.7.5.7 Summary of *Social Risk*

Social Risk tends to inhibit peer interactions as students try to save face and harm to their reputations or those of others. It tends to lessen with the building of social relationships and the building of trust, but negative experiences can exacerbate *Social Risk*. It can be reduced by making risk taking routine or legitimising it with support from role models and seniors.

3.7.6 Social Reward

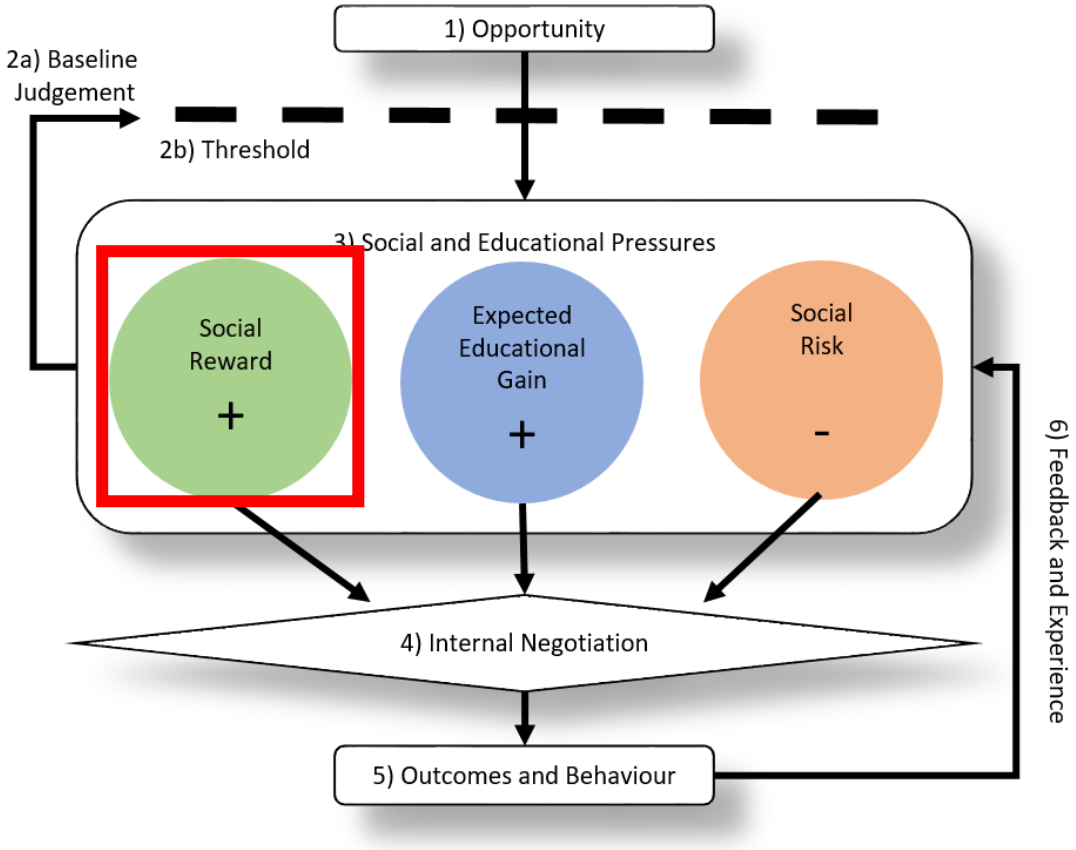


Figure 3-g Social Reward - Key Feature Highlighted

Social Reward is the degree to which you value building relationships with other students, and value their educational gain. As the *Social Reward* increases, willingness to take part in peer learning increases, as does enthusiasm for peer learning during the interaction. There are two key moderators: the *Competition Context*, and the *Social Grouping*.

During situations of high *Social Reward*, building good interpersonal relations is valued, with a feeling that you will benefit personally *and* that the other person matters. It can be difficult to separate one's own social benefit with that of others, but we can consider two types of reward – mutual and collective gain. In *mutual* gain there is reciprocity; taking turns to each perform a clinical examination, or splitting the 'resource' of a patient encounter such that one student asks the questions and the other performs the examination. There is also *collective gain*; where students collaborate to

take a history or present a case together, or shared resources very widely – a more interdependent gain than simply taking turns, and one that benefits the group.

The outlook that the success of the group matters means that an individual is more likely to work with others in peer learning activities. Whether this is true 'altruism' is a matter of debate, but as a facet of this theory it proves useful explaining 'selfless' behaviour. In a discussion of the importance of examination results, one participant raised the notion of how she would interact with a colleague who was struggling academically:

> I'm not getting anything…nothing for me. I don't want to get anything from it. It's just to get people through and get people qualified, get them through exams. Just to make everyone happy really [interview 6]

3.7.6.1 Social Grouping

One of the major variables in *Social Reward* is the notion of the *Social Group*. When the other person is considered to be in the same *Social Group* as the student, *Social Reward* is higher. For some the grouping is very open, e.g. all medical students. This general willingness is underpinned by a sense of 'togetherness', a feeling of collective benefit. *Open Social Groups* are more generally interested in group gain – 'I'll work with anyone' - and display cooperative behaviours. *Social Reward* therefore encourages peer learning. Conversely, when the outlook is of small *Groups*, only allies or close friends are included – the *Social Reward* is less and the willingness to work with the other is likely to be low unless they are in the same group. This is evident in more 'mercenary' behaviour:

> there's one person in every group who will sign up to all of the clinics and take everyone else's clinics, or like… there was someone who em… and this is quite funny actually… turned up to clinics that weren't timetabled for her and just told the person like 'I got here first, go away' [interview 1]

The *Social Group* is likely to enlarge in general terms as groups mix and homogenize – a building of relationships across the class creates a broader picture of the *Social Group*. Thus old divisions dissipate and a wider sense of being 'all medics' and *belonging* to a wider group appears.

> I think when you start out you identify, oh, I'm St Andrews, you're Edinburgh and then…even in Edinburgh they're like, I'm the Intercalators, you're not Intercalators, so there's definitely like you sort of have factions as it were but over time you get mixed around. Then you become these small groups so come end of fourth year, fifth year, I think by that time the boundaries have sort of diminished in a way [Interview 14]

This is also evident when talking about challenges to the whole group e.g. interactions with authority, experiences of adversity ('war buddies') and other events that bring a sense of common purpose.

3.7.6.2 The Competition Context

Of course time and experience does not always lead to widening of the *Social Group*. To explain why I will consider the *Competition Context*. When Competition is *overt* - it is clear that there are conflicting goals - the willingness to cooperate is less. For example, in high stakes activities such as ranking and curriculum vitae development the willingness to cooperate drops and the Social Group narrows:

> Previously in all our exams we got ranked so no one wanted to help each other [interview 2]

When the competition is *hidden* – there is no obvious conflict – *Social Grouping* is wider. This is evident in 'low stakes' environments such as formative group work, incidental teaching, tutorials etc. A good example of this is the phenomenon of the 'student intelligence network' where students share ideas, resources and other general advice through word-of-mouth, social media etc. The anonymised nature of the resource PeerWise fits here too. There appears to be great enthusiasm for writing formative assessment questions for the year group, partly because there are no overt competitive

incentives. Similarly, in 'near-peer' teaching where senior students teach junior students the formal competition between years is minimal so the *Competition Context* is relatively *hidden*.

3.7.6.3 Social Reward and Social Risk

Even when *Social Reward* is high, *Social Risk* can moderate the way it is expressed. For example, when helping others there is still a strong tendency to avoid embarrassment or harm. In the following example, the student being interviewed discusses a flatmate who failed an exam:

> So we never ever discussed it and said, tell us what you got. She came forward and said what she'd…happened. So we're sub…we're not going out of our way to teach her but, you know, subconsciously helping her by making a joke out of it and pointing at the nerves and saying, well what nerve does that movement and things like that. [interview 6]

Here it's clear that the student in question wants to help her colleague, but not expose her failure (wait until she brings it up herself) and then makes everything a joke to avoid making her feel bad.

Another aspect of the *Risk-Reward* interaction is that when the *Competition Context* is *overt* the stakes for any interaction are high and the effects of *Social Risk* are amplified. Students do not want to lose face in situations that might matter for employment or performance in summative assessment.

3.7.6.4 Social Reward in practice

The interactions between *Social Grouping* and *Competition Context* are facets of a culture of *Social Reward*. In a setting where *Social Grouping* is low and *Competition Context is high*, the culture of cooperation is minimal, whereas when the *Grouping* is open and *Competition Context* hidden, a more generally collaborative culture is apparent:.

> [At another institution], if you went home and did some work, you would do your work and they would do their work. Whereas, I feel, here, you would be more inclined 'I'll do this and you'll do that and then we'll

> swap'. It would be much more, let's see what we can gain out of this, whereas previously it was just I'll do my bit. [interview 2]

An interesting nuance is when students form relatively closed S*ocial Groups* in a fairly *overt Competition Context*. Revision groups, and groups of 'elites' will cooperate internally while competing externally with 'other students'. Hence the boundaries are carefully guarded: in deciding whether a new person could enter a study group, one student emphasised the importance of efficiency for existing members:

> We had to discuss it because we didn't want to expand too largely. We didn't want it to become a formal group because then that was part of what got us going that it was just a very easy meeting and, yes, also that means each person did ten minutes we didn't want to do it for too long unless we should lose [productivity] [interview 16]

3.7.6.5 Summary of Social Reward

Social Reward tends to promote peer interactions on the condition that the other student is considered to be in the same *Social Group* and the *Competition Context* is not too *overt.* Like the other sub-core categories it modifies with time and tends to strengthen as groups becomes more homogenized and close-knit. *Social Risk* interacts prominently with the notion of Competition Context as *overt Competition* tends to increase *Social Risk.*

3.7.7 Outcomes

This section has laid out several theoretical determinants of behaviours around peer learning. Illustrations have been used at each stage to demonstrate the nature of the concepts used, but here I will summarise some important outcomes of putative peer interactions.

1) Minimal Engagement – Embarrassment. An opportunity presents itself and the baseline judgement is sufficient to begin peer learning. However, *Social Risk* is high, perhaps because the students have never met. They might 'go through the motions' but provide little useful learning. This limits enthusiasm for future encounters
2) Strong engagement with learning. The opportunity is available, easy and includes something felt likely to be helpful such as preparation for an upcoming assessment: there is high *Expected Educational Gain*. The students know each other well, so *Social Reward* is high. They are confident in their abilities - *Social Risk* is low. There is thus highly enthusiastic and effective learning where students can challenge one another safely.
3) A partnership develops. A positive experience like 3) leads to the students developing form a more regular learning group because they are so well matched: this might be described as 'peer alignment'
4) Antipathy to peer learning. In a high stakes assessment context, *Social Reward* is low because the *Competition Context* is overt and social groups of learners they are closed. The *Expected Educational Gain* of working with non-group members is negative: helping a competitor is a loss for oneself. The *Social Risk* is high since you are showing a weakness to a competitor. Adversely competitive behaviour happens such as hiding information and resources
5) Apathy - the student has a sense of *Social Reward* and is not concerned about embarrassment – *Social Risk* is low. However she simply does not find much added benefit to peer learning, the *Expected Educational Gain* is low. Opportunities are taken if they are prompted but are not sought.

In summary, engagement in peer learning is strongest when:

a) Opportunities are easy to come by and frequent
b) *Expected Educational Gain* is high with an *Authentic, Efficient* activity and a *Credible* peer
c) *Social Risk* is low (bit not non-existent)
d) *Social Reward* is high with a hidden *Competition Context* and an *Open Group*

Having laid out the theory in some detail, I will now look at the wider literature on peer learning and ideas related to *Internal Negotiation*

3.8 The Literature Review

The purpose of the literature review in CGT is to demonstrate how the new theory relates to existing work, and modify the theory as necessary: it thus forms part of the analysis (see Section 3.4.11). Here I will outline the principles of how relevant literature was identified and integrated into the theory. I will then discuss the theory in the light of this literature.

The purpose of this chapter is to generate a theory of peer learning in the workplace. Glaser describes a theory as something that 'accounts for a pattern of behaviour which is relevant and problematic for those involved … a model of concepts that provides hypotheses about and explanations of social action' (Glaser 1978, p. 95). Such models can suggest lessons for wider implementation of peer learning, and provide ways to test the hypotheses generated (for example, do strategies to reduce *Social Risk* in fact promote peer learning?). To help form and strengthen the theory of *Internal Negotiation* then, *this* literature review will examine how the components of the theory of *Internal Negotiation* in peer learning relate to existing theory in the literature. This will give the model its relatively complete form and set the scene for future empirical work in the area.

3.8.1.1 Strategy

One challenge in CGT is knowing what to search for: the terms generated in the analysis do not necessarily match up with terms used in extant sources. The idea 'behind' *Social Risk* may not be given the same name in other literature. Similarly, the literature of many disciplines may have useful ideas for the nascent theory: research in psychology, business studies or sociology may prove relevant. It is therefore infeasible that a literature search in CGT can follow the same sorts of strategies as will be used in a more traditional 'systematic' approach (such as the one used in Chapter 4). These issues are found in other branches of social science too. In a critique of the common practice of undertaking 'systematic reviews' in the social sciences, Boell and Cecez-Kecmanovic describes several challenges including the multiple archives available, the inconsistency between researchers in the

language used to describe common concepts and the consequent difficulty in returning a useful but manageable number of search results (2010). The understanding of concepts and area of interest is likely to evolve as new literature is read. This means that search strategy is likely to change too.

This literature review seeks to situate the theory of *Internal Negotiation* in extant theory, and demonstrate how the concepts fit (or conflict) with current thinking. The starting point will be key literature on peer learning in medicine, followed by a discussion of the theoretical concepts I have developed – namely *Internal Negotiation*, *Expected Educational Gain, Social Risk,* and *Social Reward.* It is not intended that this will be comprehensive - further links could be made indefinitely. For each heading a recap of the concept in this theory will be followed by critique of relevant literature.

The search strategy within the medical education literature was relatively traditional (described in 3.8.2 Existing Theory in Peer Learning below), but the search strategy for the other concepts was broader. Many texts were identified through reading the reference lists of medical education articles on peer learning, but others were identified by searching non-specialist systems e.g. Google Scholar with broad terms such as ‘competition and education’. Further important ideas were found through conversations with colleagues, my general knowledge of scholarship on team work, and serendipitous findings like an interdisciplinary text on cooperation (Sullivan, Snyder, and Sullivan 2008a). A predefined search strategy could not easily identify such a diverse set of sources. The benefits of such an expansive strategy should become clear as insights from psychology, management studies and primary education all inform the nascent theory.

3.8.2 Existing Theory in Peer Learning

I will identify some key papers on peer learning theory in the medical context. The emphasis will be on what these texts identify about ‘explaining’ peer learning in the terms of the definition of grounded theory above, rather than report empiric results of specific peer teaching designs.

Web of Science, Google Scholar and Pub Med databases were searched to identify studies relating to undergraduate medical students. Search terms included 'review' 'peer learning', 'peer teaching', 'peer assisted learning', 'clinical education', 'medical education'. In addition the reference lists of identified articles were hand searched to find other relevant papers. Studies were selected to identify major theoretical insights, either because they were review articles with a discussion of relevant theory, or they were empirical studies that sought to develop theoretical models. Again this strategy is not considered exhaustive, but the focus on reviews should identify the most commonly cited theory.

3.8.2.1 Results

One classic text on peer learning in the general educational literature is provided by Topping (1996); it discusses medical education so is included here. Topping reviews the theoretical benefits of peer tutoring including the benefits to the peer teachers themselves such as improved student motivation, self-esteem and empathy between students. Disadvantages are considered to be practical (arranging time for training and resources for delivery) or relate to the notion that peer teachers may deliver inferior quality teaching compared to professional teachers. A subsequent review of the experience in using peer learning in school and undergraduate peer teaching programmes highlights proven superiority of well established 'brand name' near peer teaching programmes such as the Personalised System of Instruction. Reciprocal training of same level dyads has been shown to be superior to individual study in psychology, especially when the nature of the peer-peer interaction is highly structured rather than open-ended (Fantuzzo *et al.* 1989). Topping, then, sets the scene for much of the literature in peer learning by focusing on potential benefits and evidence of educational effect.

In a review of the way that theory informs peer learning in medicine, Ten Cate and Durning (2007b) also discuss the potential benefits to peer learners. For example, in psychological theory the idea of 'cognitive congruence' – discussed in Lockspeiser (2008) - suggests that learners at a

similar level of educational attainment might better understand one another's learning needs than a more senior teacher. This draws on the idea of Vygotsky's 'zone of proximal development' (Vygotsky 1978) where a student's learning is likely to be focused on incremental gains close to their current level of understanding. A peer may have a better understanding of what is 'proximal' to their colleague than a senior at a more distant level of expertise and so be better placed to help fill the gap (Ten Cate and Durning 2007b). Closely related is 'social congruence' where peers can provide friendship and role modelling in a way that senior teachers cannot. The more equal power balance between peers could also facilitate the 'disclosure of ignorance and cognitive errors' that they may wish to hide from someone in a position of relative authority (Ten Cate and Durning 2007b). The article also suggest ways in which various peer learning can contribute to many levels of Maslow's hierarchy of needs, a hypothesized pyramid that starts with universal but basic needs such as physical safety and ends with non-essential but highly desirable needs such as 'transcendence' (Maslow 1987). The 'cognitive needs' level can be satisfied by a peer tutor demonstrating mastery of a topic when teaching a colleague, and the 'transcendence' level could be satisfied by the altruistic experience of helping peers (Ten Cate and Durning 2007b). The review thus identifies theoretical reasons that peer teaching *would* benefit students. It fits closely with the findings in this thesis on *Expected Educational Gain* and the *Authenticity* of proposed learning activities. Students would, for example, be more likely to consider a learning activity to have *Authenticity* if it is considered to have cognitive congruence, such as the learning of skills understood well by both students. The 'social congruence' theory resonates more strongly with the *Social Reward* – the interpersonal gains afforded by supportive peer-peer interactions that would in turn promote future peer learning.

However, the overview by Ten Cate and Durning does not explicitly identify the theoretical drawbacks to peer learning. Notably, the assumption about trust between peers quoted above is contentious given the findings of this thesis on *Social Risk.* The language of the paper tends to treat peers as a

homogenous group e.g. ‘Students, taught by peers may also be motivated to spend more effort in studying’ without identifying which students and under which conditions. The notion of ‘social congruence’ would seem to apply *if* there are positive social connections between peers. Social congruence may be higher in general between peers than between peers and seniors, but studies of unprofessional behaviour at medical school document many instances of poor conduct *between* students (Papadakis *et al.* 2005).

Tolsgaard looks at collaborative learning (a subtype of peer learning) and reports several reasons that support its use including the idea of social and cognitive interaction, referencing ideas very similar to those in Ten Cate and Durning’s paper (Tolsgaard *et al.* 2016). This includes a description of social interdependence theory which can be positive (as in high *Expected Educational Gain*) but also negative, where ‘learners perceive that they can only be successful if others fail’ (Tolsgaard *et al.* 2016, p. 71). Tolsgaard goes on to describe motor skills learning theory that reviews the role that efficient practice and ‘mirror neurones’ all add to the skills gain in peer learning. This review then mostly dwells on the *Expected Educational Gain* aspect of this theory, with some reference to positive *Social Reward*.

A systematic review of the medical literature on peer tutoring (Burgess *et al.* 2014a) concluded with similar perceived benefits for tutors and tutees. These included development of deeper domain-specific knowledge and skills as well as professional attitudes related to teaching generally. The review found little evidence of resistance to peer tutoring amongst students, though noted that some tutors reported feeling awkward. It noted that most peer tutoring programmes included some basic training in how to teach, but that the effect of this training was rarely evaluated: skill and confidence in peer tutoring may be a relevant predictor. Again while this review contributes to an understanding of what students might get from teaching, it does not clearly identify what governs whether this happens.

In a systematic review of peer learning in the clinical context of hospitals and clinics, Tai *et al* (2016) seek to identify both positive and negative aspects of

peer learning. The paper benefits from a well described search strategy that seems likely to include the most relevant papers. Again they identify many benefits to students, teachers and patients including improved abilities in forming clinical judgements, clinical skills, developing teaching skills, and building rapport between students. Pitfalls included the limited ability of students to make good judgements and that significant numbers of students are uncomfortable being evaluated by their peers. 30% of students in a study on professionalism felt such peer judgements were inappropriate (Kovach *et al.* 2009). They also find evidence that some students refused to take part in peer learning at all (Tai, Molloy, *et al.* 2016). This paper adds evidence for the phenomena that support peer learning and relations between students – captured in this thesis by the idea of *Expected Educational Gain* and *Social Reward*. While Tai *et al* treat these as fairly generalizable advantages of peer learning - rather than variables in a case-by-case model – they do recognise the heterogeneous nature of peer groups and the potential drawbacks of widespread implementation of peer learning.

In a related paper, Tai and colleagues (2016b) also built a model of the way that peers can help one another build 'evaluative judgement' – understanding work quality in a way that can be applied to appraising performance. Their model includes various inputs that help students understand what constitutes good performance and be able to identify it. In this model peers are classed as generally providing a supportive role – they encourage 'thoughtful risk taking' which fits with the notions of social congruence mentioned already. They do note the way that peers may be concerned about giving one another offence (*Social Risk*), though this is not explicit in the final model.

Another review by Herrmann-Werner *et al* (2017) surveys peer learning across several medical school contexts and identifies many positive gains: - improved knowledge, skills, confidence, ability to admit to clinical uncertainty etc. and that tutees will find it easier to understand one another's teaching and discuss the hidden curriculum. The drawbacks appeared to be few e.g. peer learning is time away from 'experts' and they found some examples of

'reduced academic performance' after being taught by peers. Again these match the *Expected Educational Gain* category. We might question the very optimistic conclusions.: 'PAL … offers lots of benefits with only little [sic] potential drawbacks to justify its existence (Herrmann-Werner *et al.* 2017).'

These concerns are important – as an example of the challenges a peer learning programme might face, Bennett and colleagues analyse a programme of peer-led workplace-based assessment in hospital wards (Bennett *et al.* 2015). They found several barriers including concerns that peer learning was thwarting opportunities to learn from experts, and significant social concerns about 'burning bridges' with peers if they engaged in overly critical feedback. These again could speak to the perceived poor *Authenticity* of some peer learning events and its reduced *Efficiency* in comparison with time spent on senior led teaching. The *Social Risk* element is evident in the 'burning bridges' statement.

It is worth looking at Bennett's theoretical framework in more detail. They used 'activity systems methods' (Yamagata-Lynch 2010) to analyse multiple aspects of a social phenomenon – in this case peer learning. These aspects include the Tool (here their PAL learning activity), the Object (learning in the clinical Setting) the Subjects (junior students), Rules (learning as participation in a wider group), Community (the students, doctors and patients) and Division (students sharing time and resources) (Bennett *et al.* 2015). This alternative model of peer learning has identified some of the same phenomena as *Internal Negotiation:* compare the importance of *Opportunity* with their focus on a Tool and an Object. It also reports differences akin to *Skill* in *Internal Negotiation*, where older students (studying medicine as postgraduate entrants) were better able to moderate the effects of social embarrassment. It is not identical though – there is relatively little discussion of the importance of *Competition Context*. It also describes the factors that are present, but it is not always clear how we might vary those factors to promote learning.

3.8.2.2 Summary of Review of Medical Literature

This overview of theory and current thinking in peer learning has highlighted several important points. First, much current literature seeks to identify reasons why peer learning is equivalent to or better than senior-led learning. As we have seen, these studies tend to treat 'peers' as a single group with shared characteristics. The theories in place – such as social congruence – are also invoked as a way of looking at groups of peers together. With some notable exceptions – such as Bennet's work (2015) - there is less emphasis on modelling the individual complexity of peer-peer interactions to explain why peer learning does not always occur. Drawbacks are noted, but not satisfactorily integrated into theory *per se*. This matters because a richer understanding would allow us to avoid the pitfalls and design better peer learning. These pitfalls include the refusal to take part in peer learning noted by Tai *et al* (2016). Furthermore, the medical literature does not in general state how students might balance the benefits and drawbacks of peer learning – there is no clear equivalent to *Internal Negotiation* in the texts above.

The following sections of this literature review will look at the theory of *Internal Negotiation* developed in this thesis, using its terms as starting points for finding related medical and non-medical literature.

Table 3-D summarises the relevance of cited work to the concepts in the theory of *Internal Negotiation.* The text that follows explores the theories summarised here.

Table 3-D Overview of My Grounded Theory Concepts Covered by Cited Work

Summary of whether cited literature relates to the individual concepts in this thesis e.g. Game Theory has relevance for *Internal Negotiation* and *Expected Educational Gain*.				
Theory and Key References	**Internal Negotiation**	**Expected Educational Gain**	**Social Risk**	**Social Reward**
Activity Systems Theory (Bennett *et al.* 2015)	Some – see text	Yes	Yes	Some see text
Cooperative Learning (Johnson and Johnson 2009)	-	Yes	Some	Some
Credibility (Watling *et al.* 2012)	-	Yes	-	-
Game Theory (Blake and Carroll 2016)	Yes	Yes	-	-
Group Engagement Model (Tyler 2008)	-	-	-	Yes
Individualism-Collectivism (Chen *et al.* 1998)	-	-	-	Yes
Medical Education Reviews e.g. (Topping 1996, Burgess *et al.* 2014a, Tai, Molloy, *et al.* 2016, Herrmann-Werner *et al.* 2017)	-	Yes	Some	Some
Psychological Safety (Edmondson 1999)	-	-	Yes	-
Sullivan Snyder and Sullivan's synthesis (2008)	*Some*	*Yes*	*Yes*	*Yes*
Social / Cognitive Congruence (Ten Cate and Durning 2007b, Tolsgaard *et al.* 2016)	-	Yes	-	Yes
Social Anxiety (Laidlaw 2009)			Some	
Social Interaction Theory (Van Lange 2008)	*Yes*	*Yes*	*Some*	*Some*
Team efficacy (Gully *et al.* 2002)		Yes		Yes

3.8.3 Internal Negotiation

> **Definition**: The active balancing of competing tensions in a peer learning encounter.

A crucial notion in *Internal Negotiation* is that there are potential conflicts of interest in peer learning which the student must balance. Furthermore there are multiple kinds of interest – those that are about personal gain, personal risk, benefits to the group and so on. How does the literature inform this?

One similar notion in the medical education literature is the way that game theory could model peer interactions (Blake and Carroll 2016). In this field, hypothetical games are used to examine the idea of a risk/reward calculation under various conditions. One widely used game is the Prisoner's Dilemma. The two participants are 'prisoners' who have committed a crime together but been captured. They must now make a decision about whether to 'defect' and give evidence against their partner, or 'cooperate' with the partner and keep quiet. If *both* prisoners cooperate, they receive only a trivial prison sentence. If they *both* defect, they receive a moderate sentence. However, if one defects and the other cooperates, the defector receives a very light punishment and the co-operator takes the full blame, receiving a severe sentence. There is thus a dilemma – cooperation could lead to modest success or severe penalty – defection could lead to great success or moderate penalty. In the words of one such game theorist '*Both* players would be better off if they both cooperated rather than defected, but for each it *always* pays more to defect' (Hanley *et al.* 2008, p. 36). The relevance of such games to educational settings is laid out by Blake and Carroll (2016). For example, in a situation where a pair of students have the opportunity to help one another through peer learning, they may consider whether they are likely to win or lose through this approach. This risk/reward structure has some resonance with the idea of the *Internal Negotiation* of potentially contradictory pressures. It aligns most clearly with *Expected Educational Gain* which is a form of educational 'reward' for taking part, though could be a

'cost' if it is considered that taking part will harm one's goals (Negative *Expected Educational Gain*).

Nevertheless, this model of so-called 'instrumental' cost and benefit does not fit completely with ideas such as *Social Reward* where there is a more altruistic motivation, or a group identity. The traditional game theories focus on how individuals would make purely 'rational' and self-interested decisions. As we will see in the discussion below, it seems likely that other factors are at play in the field of cooperation (Hanley *et al.* 2008). Moreover, it is not always clear that such conscious decision making is appropriate to real life situations (Hagen and Hammerstein 2006). Other games exist that test things like coordination of effort, but again these are slightly abstracted from the day to day influence of multiple contextual factors.

This is reflected in the synthesis put forward by Sullivan *et al* (2008b) in their introduction to an interdisciplinary book on cooperation. They develop a model that draws on insights from psychology, sociology and organizational research. It begins with a decision to be made about whether or not to cooperate that considers both instrumental gains and social factors like whether or not there is enough trust to proceed (akin to the *Threshold* of *Internal Negotiation)* and the notion of repeated cycles of these decisions.

> at any given point in time, every human being is engaged in this sort of evaluation, and is deciding whether and how to cooperate with various individuals and groups … since this is an iterative process, individuals will respond to such an environment by increasing or maintaining their level of cooperation (Sullivan, Snyder, and Sullivan 2008b, p. 10)

The study by Bennet *et al* (2015) of medical workplace learning quoted above also supports this idea that both opportunity and an individual decision are relevant. Bennet draws on work by the psychologist Billett (2008), that discusses the 'relational independence' between wider social structures and individual decision. The former may take the form of 'affordances' – opportunities – and the latter 'agency' or individual choice.

The agency element is also discussed by the psychologist Van Lange (2008) who discusses the 'individual differences' (psychological constructs that vary amongst individuals) that are likely to play a role in decisions about cooperation or other 'prosocial' behaviour. He stresses that it is not simply a matter of the risk or benefit to the individual, but that there is evidence that other traits like 'competitiveness' or a desire for *collective* outcomes that are also necessary to explain the range of behaviour seen in cooperation decisions. At a broad level, *Social Reward* could be conceived to be such a trait, where high *Social Reward* compromises a strong desire for collective gain. Van Lange's collections of personal traits combine with contextual features in the 'social interaction model' where outcomes depend on who is present, what the context is and what the traits are. Again this fits with our notion that each decision in *Internal Negotiation* is situation- and individual-dependent, rather than blanket approaches to 'peer learning vs senior-led learning'. This takes particular prominence in van Lange's article where he discusses the paradoxical effects of each of these traits – competitiveness can promote group cohesion if two *groups* are competing for something desirable e.g. the 'cleanest city award'. A tendency for cooperation could be highly undesirable if the aim is to inflict as much damage as possible as in the case of soldiers in armies. Again this warns us of the perils of assuming that all peer learning is good: a well-publicised example of medical students cheating through the 'cooperative' sharing of assessment questions is instructive (Bodkin 2017).

In summary the principle features of *Internal Negotiation*– that it is a balancing process that depends on multiple types of personal and contextual influence, that there is both a *Threshold* aspect and an *iterative* aspect, and that a purely personal cost/benefit model is insufficient - are consistent with the wider literature in social behaviours. I now turn to the sub-categories.

3.8.4 Expected Educational Gain

> **Definition:** The judgement of how likely the encounter is to help the student achieve educational aims

As I have detailed already, much of the existing literature in medical education has focused on the perceived educational benefits of peer learning, suggesting *Expected Educational Gain* is indeed a significant concern for students and teachers in peer learning.

This also speaks to the notion of instrumental achievement that we saw in the discussion of Game Theory, where the calculation is about whether you will get something you value. Similarly, the extensive research by Johnson and Johnson (2009) on 'Cooperative Learning' lays out the key features that define it and make it successful including positive interdependence (the success of one depends on the success of all) and the importance of experience and seeing the positive results of cooperation. These are akin to *Expected Educational Gain* where the peer learning of the task is seen as *Authentic* and *Efficient*, and positive experiences have a reinforcing character. Cooperative Learning also depends on and influences social relations and psychological health – so has links with *Social Risk* and *Social Reward*.

A key part of *Expected Educational Gain* is *Credibility* – can a peer provide teaching that can be trusted or considered useful? This concept arose from the primary data analysis, but the term itself has been borrowed from Watling's paper on how students use feedback (Watling *et al.* 2012). He describes how learners gauge whether or not to accept feedback based on a judgement of factors such as the expertise of the teacher, whether or not they have witnessed the behaviour etc., and summed this up as a 'credibility judgement.' In this theory I use the same word as applied to peer learning – has the peer got the expertise and opportunity to make good judgements, is the teaching trustworthy? There is frequent empirical evidence for this in the peer learning literature, with concerns raised by students that their peers may not have the requisite ability to make good judgements of a peer's

performance (Glynn *et al.* 2006, Rees *et al.* 2016); calling this *Credibility* names the pattern.

Team work is not synonymous with peer learning, but in the literature on team work we can find concepts that resonate with the ideas in the current theory. If *Expected Educational Gain* is in part a belief about the effectiveness of a peer interaction, then the notion of 'team efficacy' found in the psychology literature seems relevant (Gully *et al.* 2002). Defined as 'perceptions of task-specific team capability', team efficacy is a belief in whether or not the current team can achieve the task set. In Gully's meta-analysis this seems to be positively correlated with outcomes i.e. belief in success helps predict success. If *Expected Educational Gain* does indeed continue to promote engagement with peer learning during an interaction, it would make sense if it has a similar impact on outcomes to team efficacy. Further, the idea of team efficacy may stem from a belief that the outcome of the group depends on all the individuals (Alavi and McCormick 2008)– this suggests the possibility of a link between *Social Reward*'s notion of shared outcomes and *Expected Educational Gain*. This is supported by the design of Team Based Learning, a form of peer learning where testing strategy makes it clear to students that their individual performance will be boosted by cooperating with their team mates (Parmelee *et al.* 2012).

3.8.5 Social Risk

> **Definition:** The concern for exposing oneself or others to social harm, embarrassment or reputational damage

That emotion affects learning is not a new discovery. Eva *et al* (2012) describe the impact of emotion on receptiveness to feedback. They report how even senior physicians can be afraid of looking ignorant in front of patients. In states such as this receptivity to feedback is likely to drop; they identify this as something to overcome. This chimes well with the description of *Social Risk*. Again the medical literature on experiences of peer learning continues to bear out the idea that risk of offending or looking stupid inhibits peer interactions, even when the general feeling is of support

(Arnold *et al.* 2005, Tai, Canny, *et al.* 2016b). This is an old concept, where a 'cloak of competence' aims to cover up social shortcomings (Edgerton 1971).

Social anxiety is a related concept, defined as a mental health disorder characterised by 'dread of social situations' due to the risk of looking foolish (Laidlaw 2009). In a study of communication skills training that included a peer group, around 8% of medical students reported levels of anxiety that met pathological clinical criteria; this adversely affected their enthusiasm for participation in training (Laidlaw 2009). This can be considered an extreme end of the self-oriented part of *Social Risk.*

In this thesis I considered factors that might reduce *Social Risk* such as a focus on building trust and safety in student interactions. The notion of psychological safety was originally put forward in a study of team work in business (Edmondson 1999). Edmondson describes how – in addition to technical inputs to team work such as task design and resource availability – there is increasing evidence that interpersonal factors affect team outcomes. Psychological safety is 'a shared belief that the team is safe for interpersonal risk taking' such as sharing ideas or suggestions (Edmondson 1999, p. 354). In a mixed methods study she first finds evidence that psychologically 'safe' teams exhibit more learning behaviour (such as seeking feedback, talking about mistakes and experimenting (Edmondson 1999). She then goes on to demonstrate that this correlates with improved performance in team tasks. Similar results have been found in high school education, where increased psychological safety was correlated with more learning behaviours, though not necessarily improved outcomes (Van Gennip *et al.* 2009).

Psychological safety is thought to be a key component of effective team working across multiple fields including medicine (Salas *et al.* 2008, Weaver *et al.* 2010) and is taken to be an essential part of educational design in medical simulation (McGaghie *et al.* 2010). There is also evidence in the feedback literature that a healthy culture of feedback depends at least in part on the safe and supportive attitude of one's colleagues (Watling *et al.* 2013a,

Harrison *et al.* 2016). Team work literature also references the potential impact of *psychological* safety on *patient* safety – when concerns about self-image take precedent they can reduce error-reporting (Madigosky *et al.* 2006), and psychological safety was cited as the main mediator between power dynamics and intention to report patient-safety failures in doctors (Appelbaum *et al.* 2016).

This description of how increasing safety promotes better learning fits with our notion of *Social Risk* and its (generally) dampening effect on learning behaviours such as participation in peer learning. A study of peer learning in clinical education also identified the potential for interpersonal risk when designing peer learning events (Sevenhuysen *et al.* 2017), though this was not evident when they actually implemented peer learning (Sevenhuysen *et al.* 2014). On the other hand, as a general phenomenon one of the features of social congruence is considered to be an environment supportive of risk taking (Lockspeiser *et al.* 2008, Tai, Canny, *et al.* 2016b, Young *et al.* 2016) which argues that *Social Risk* is active in these cases, even if it is generally lower than expert-led teaching.

As identified in my Grounded Theory, though, a degree of risk taking is probably important. When there is trust but no risk, the possibility of groupthink arises where everyone is just keen to get along, but not challenge one another (Ronson and Peterson 2008). A more useful state is 'trust with risk' where there is belief in the safety of critique and its usefulness. In this deeper state of cooperation we could imagine that two students who have built a state of trust can reduce the effects of *Social Risk* so that they can push one another to achieve more. This would account for the value of some ongoing sense of *Social Risk* in promoting the *Authenticity* of an encounter.

Trusting relationships between individual students are clearly important in peer learning. Riese ***et al's*** review (2012) of 'interpersonal theory' begins by pointing out that much debate about peer learning has focused on 'instrumental' features such as measured learning gains, instructional design etc. without much emphasis on social relations. Integrating findings from

school students and (non-medical) undergraduates, they highlight how the success of a peer-peer encounter depends on multiple factors including on the way students discuss and share tasks, handle disagreements and build trust, and build 'relational knowledge': getting to know one another and learning how to act together. The parallels with *Social Risk (*handling disagreements*) Social Reward* (getting to know one another) and the *Skill* aspects of *Internal Negotiation* are clear. Similarly, they give several examples where poor alignment of these factors leads to failed peer learning activities. This is important because it stresses that when it comes to peer learning, context and situation matter – one size does not fit all.

3.8.6 Social Reward

> **Definition:** The concern for building relationships and helping others reach their goals

Again the wider literature can provide insights into the nature of *Social Reward*. Looking at the factors that govern individual behaviour in teams (taken as analogous to peer learning), Tyler (like Riese) contrasts the 'instrumental' effects of incentives and punishments with 'intrinsic motivation' or values and beliefs (Tyler 2008). The argument is that while the former *can* encourage individuals to help colleagues, they are inefficient, requiring large and continuous resources from outside groups such as leaders, governments or society. If these external influences are dropped - perhaps in times of resource scarcity – group members are left with little to encourage cooperative action. On the other hand, 'intrinsic motivation' arises from what he terms the 'Group Engagement Model'. This has 3 components – attitudes and beliefs, considerations of procedural justice, and the effects of identity. Tyler has found that voluntary behaviour to help the group is more closely related to commitment to a role than specific incentives for doing so; you will go the extra mile for an institution you believe in. Similarly, whether you think the rules and systems in place are fair – procedural justice - is a strong indicator of your willingness to take part in voluntary helping behaviour.

Finally, there is evidence that the degree to which you identify with the rest of the group – 'we' not 'they' – also predicts your willingness to contribute. These findings are based on empiric evidence, and lead to Tyler's conclusion that when they are favourable they result in strong internal motivation to help others.

This idea is closely linked to Ryan and Deci's notion of self-determination (referenced in (Ten Cate *et al.* 2011)), which Tyler also cites. In relation to the present theory, these notions are linked most closely with *Social Reward* – seeing value in helping the group - though the procedural justice element speaks of safety and *Social Risk* reduction too. It is not that the more instrumental character of *Expected Educational Gain* is negligible, but it does suggest that its prominence in literature in medical education is disproportionate.

One of the features of *Social Reward* is the *Competition Context* – how obvious it is that there is direct competition between students. For example, if ranking and the award of grades makes it clear that students are in competition, might simple pass/fail assessment structures improve *Social Reward*? Groups that have introduced this in an effort to make students more cooperative and cause less stress have had some success (Jacobs *et al.* 2014, McMorran *et al.* 2017). This supports the idea that fixed competition structures can alter willingness to compete in peer to peer learning. At the other extreme, studies suggest that high competition can lead to frankly harmful behaviour between students. Rees and Monrouxe's paper on abuse in medical school notes that one of the structural factors that enables abuse is the presence of

> Motivating structures and processes, such as high internal competition and expected benefits of abuse to the perpetrator (e.g., gaining a higher ranking in the organization relative to peers) (Rees and Monrouxe 2011, p. 1379)

The other major aspect of *Social Reward* is the *Group Conceptions* factor – whether or not you feel that you and your putative partner are part of the same grouping. This in part comes from literature on ingroups and outgroups which documents the human tendency to categorize others as being similar to themselves - the ingroup - or different - outgroup (Dovidio *et al.* 2008). This categorization entails various cognitive biases (Kahneman 2011), notably seeing the ingroup in a more positive light and the outgroup in a more negative light, with documented effects on the willingness to help them (Dovidio *et al.* 2008). The us/them distinction appears to be very powerful, but we should note that it can be paradoxical – as van Lange points out, competition *between* groups could be seen as a positive thing if both groups then excel e.g. getting the best grades (Van Lange 2008). Still, the dark side to intergroup conflict – considering other groups to be composed of worse individuals less worthy of respect – prompts a search for ways around it. Dovidio and colleagues propose the Common Ingroup Identification Model (Dovidio *et al.* 2008), where in addition to one's subgroup identity one has a wider group identity – both British *and* European, or a member of one clique *and* part of the medical profession. This 'dual identity' might harness the positive effects of both intergroup competition and intergroup collaboration, or in the current framework widen the *Social Grouping* in order to boost *Social Reward*.

Sense of identity can also be seen through the lens of whether or not students are focused on themselves or the wider group. Individualism-Collectivism is the 'extent to which people in a society value working together to achieve collective goals' (Marcus and Le 2013). It was initially developed by Hofstede as a part of a way to understand whole cultures and their structures, along with other dimensions such as the importance of 'power distance' and long-term vs short-term orientation (Hofstede 1980, 2001). Societies like the United States of America are considered fairly individualistic, and the culture of China considered more collectivist (Nardon *et al.* 2008). This orientation can also be considered at individual or organizational (group) level. For my purposes, the Individual level of the

construct seems to fit well with *Social Reward*'s general effect of promoting engagement with peer learning – an individual with a more collective outlook being more interested in group gain (Marcus and Le 2013). One can see how the varying degree of Individualism-Collectivism found in different populations could significantly affect their willingness to learn together. This fits with the sort of personal orientation found in the psychology literature (Van Lange 2008). Furthermore, the degree of Individualism-Collectivism at the *organizational* level is thought to influence cooperative behaviour at the *individual* level (Chen *et al.* 1998, Marcus and Le 2013); medical schools set up to be more collectivist in outlook would then be expected to encourage more cooperative behaviour amongst students.

In a medical context, Chou and colleagues investigated the effect on prior learning relationships on the quality of peer feedback on communication skills given by medical students (Chou *et al.* 2013). Students who had previously worked with their partner were more likely to give constructive feedback than those who had never met their partner. Again this study was somewhat small (46 students) but lends support to the idea of *Social Reward* being able to mitigate the effects of *Social Risk.* Another study interviewed students about the groups they formed at medical school (Lovell 2015). Whilst not a study of peer learning *per se*, it did include findings similar to the idea of *Social Reward* including the supportive nature of peer support groups, but also their sometimes competitive and critical nature (akin to *Social Risk).* Another study found that measures of group belonging correlated positively with measures of student wellbeing – being part of a group may be protective (McNeill *et al.* 2014). On the other hand, it also suggest that a group with negative values (group norms) could have detrimental effects. Once again the vicissitudes of peer relations are neither uniformly positive nor uniformly negative.

In summary *Social Reward* finds correlates in medical and non-medical literature that have influenced this theory. It appears to be more powerful

than is generally recognised, and adds a level of nuance to peer learning beyond simply ‘peers get along’.

3.9 Conclusions

3.9.1 Summary of the chapter

In summary, this chapter has argued for the importance of predictive models in medical education and identified a gap in relation to peer learning. It has described and critiqued the use of Classic Grounded Theory to develop such a model, and presented the theory of *Internal Negotiation* as a plausible solution. For clarity, the simplified overview diagram (Figure 3-c) of the theory is reproduced again here.

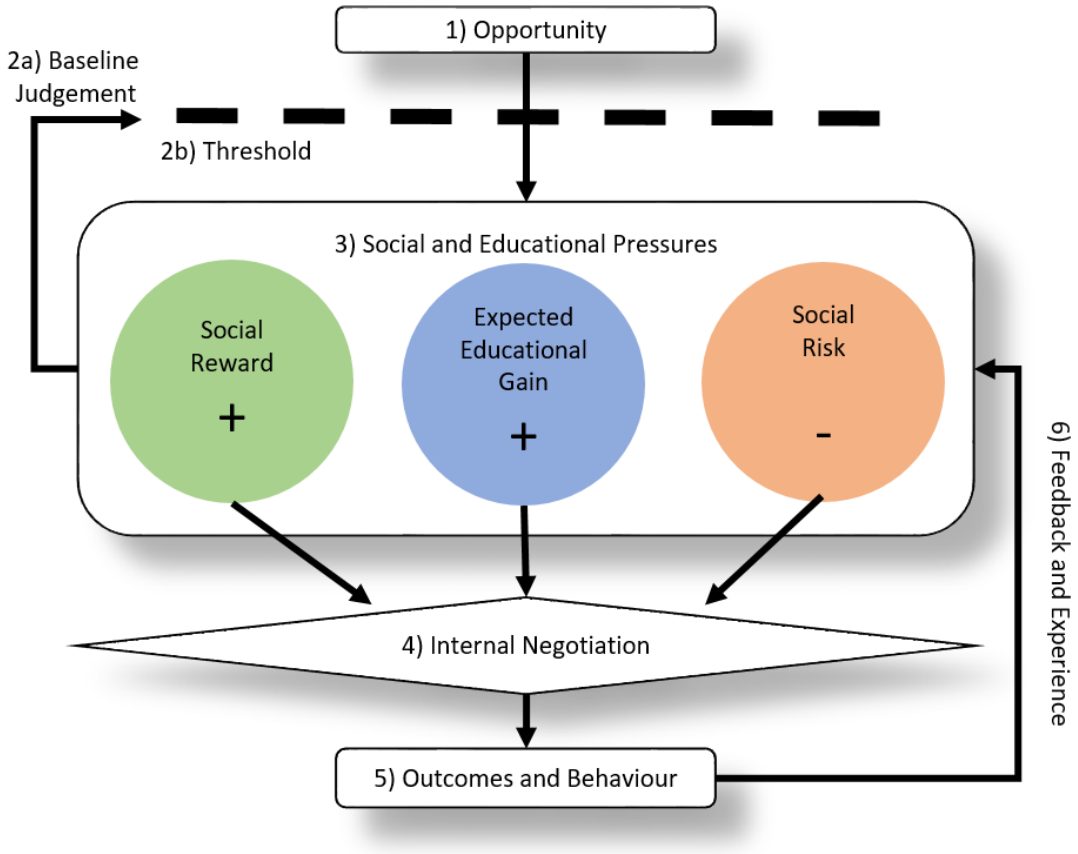


Figure 3-h Simplified Overview of the Theory

This theory represents a simple but powerful way of considering student interaction in peer learning which has identified variables likely to alter outcomes. For example, efforts to demonstrate the *Expected Educational Gain* of a peer learning teaching project are likely to make students more receptive to it. I will discuss some more such implications later, but first I will consider what this theory adds to existing literature.

The literature review identified multiple papers and theories on peer learning from both medical and non-medical literature. What this theory of *Internal Negotiation* adds is a holistic view, where most other theories focus on just one aspect of peer learning. The medical education literature in particular has painted a broad-brush picture of peer learning as being 'generally good' with just a few drawbacks, and in many cases failed to provide a satisfactory account of why some students do engage in peer learning and others do not. Much of the literature has emphasised the instrumental gains covered under *Expected Educational Gain*. Where more socially-oriented theories such as social congruence are cited, this is often in the vein 'peers will get on better with one another than with seniors'. This generalisation may be useful in strategic decisions about whether or not to use peer learning, but provides little help in planning individual teaching projects or explaining individual behaviours.

Looking more widely, many theorists point out the situation and context-dependent nature of student interaction. The insights from game theory, psychology *et al* all presuppose individuals making decisions based on the assessment of current conditions. Blanket statements about 'peers' versus 'experts' give way to 'this peer' and 'in this situation.' This is the kind of thinking that gives rise to the concept of *Internal Negotiation* – the constant balancing of shifting pressures to guide decisions moment-to-moment.

Another strength of *Internal Negotiation* is its inclusion of both educational and social pressures in one model. As we saw in

Table 3-D, most cited literature illuminates only one or two aspects of this decision making. Social congruence *a la* Ten Cate and Durning's review (2007b) is powerful but does not integrate strategic decisions on educational value; game theory (Blake and Carroll 2016) focuses on instrumental value but neglects the role of personality and intrinsic rewards.

There are some exceptions to this. Bennet's valuable contribution using activity systems theory (Bennett *et al.* 2015) is deliberately multidimensional and covers similar ground to my theory. However, it does not identify the importance of *Competition Context* or task *Authenticity.* It also relates particularly to the type of peer learning teaching they developed (clinical peer assessment) which may not transfer to other peer learning tasks. This is not to detract from their model, but it defends the choice of CGT as a methodology for this theory. Rather than start with a predefined framework as Bennett does, CGT can identify things that preconceived structures might not. Bennett's model provide support for the plausibility of my theory, and has in turn modified it in keeping with CGT method. This also emphasises how different methodologies can result in similar but not identical endpoints.

Both cooperative learning (Johnson and Johnson 2009) and the synthesis provided by Sullivan *et al* (2008a) in their interdisciplinary work also bridge multiple theoretical domains. However the content of their theory does not relate specifically to the clinical context. One advantage of grounded theory is that it can develop theory relevant to a specific setting (what Glaser calls 'substantive theory'). It is gratifying to find similar notions in these fields, but perhaps more useful for a medical teacher to find work developed particularly for her area of practice.

3.9.2 Practical Implications of the Theory

A potential drawback for this theory is its simplicity. It combines multiple complex notions into a neat (and as yet unverified) model. Hanley et al (2008) write about the challenge of modelling and empirical data:

> The problem is to find a "model of human agency" that is both defendable in light of actual human decision processes *and* simple enough to be a useful tool for building deductive models… Scholars differ on the trade-offs they are prepared to make between how simple their behavioural models are and how well the assumptions underlying those models fit the empirical data. (Hanley *et al.* 2008, p. 35).

The complexity inherent in peer learning is great; the model I have presented is simple. Nevertheless, to take up the challenge of Hanley, this section will present some of the implications of this 'simple' model that may guide teachers.

3.9.2.1 Internal Negotiation

Firstly, the facets of *Internal Negotiation* suggest that teachers should attend to the following domains:

Opportunity – provide students with multiple, easy, routine and well-advertised opportunities to take part in peer learning. It should be clear what students have to do and require little administrative or logistical planning to achieve this.

Internal Negotiation – recognise that it is not as easy as 'peer learning works.' Students have complex decisions to make and this will depend on the task, who they are partnered with, how many times they have met *etc.* This balance is dynamic both within a session and over time; providing multiple chances and training in how to balance these pressures is likely to improve *Skill* at *Internal Negotiation* and satisfaction with the results.

3.9.2.2 Expected Educational Gain

Promoting the intended educational benefits of peer learning – and aligning it to their goals – is helpful. An emphasis on preparation for summative assessment or skills related to everyday clinical practice are likely to be 'easy sells,' particularly if peer work is seen as complementary (the insights of *Authenticity*). Consider learning designs that make the added benefits of

peer work inherently obvious, as in Team Based Learning's testing strategy (Parmelee *et al.* 2012)

3.9.2.3 Social Risk

Give clear advice and training on how to behave, and make it easy to help colleagues without causing offence. This may include use of senior tutors at least early in the project, approved marking schemes to legitimise critique, and low stakes settings such as formative training to reduce the consequences of poor performance. Since risk suggests there is always *some* danger of harm, take care to ensure appropriate support mechanisms are available should things go wrong. Again, providing multiple opportunities over a long period of time should help build confidence that risk taking is worth it and that the consequences of participation are positive, not negative.

3.9.2.4 Social Reward

Build relations between students by integrating teaching into longitudinal structures over several months. A wider culture of common identity (perhaps by promoting group social activities and interactions) should also build *Social Reward* and make it more desirable to help one's colleagues. Resist competition structures such as formal ranking by grades, and take care in using peer learning in summative settings, particularly where peer assessment is used.

As part of the dissemination of the findings of this research, a one page guide for other educators was produced and uploaded to the University web pages (Appendix 3).

3.9.3 Quality of this study

To critique the quality of this work, I will use the quality criteria set out in the methodology section, namely the principles of fit, work, relevance and modifiability. The definitions are reproduced in Table 3-E:

Table 3-E Quality Criteria in Classic Grounded Theory (reproduced from Table 3-B)

Fit the categories and codes must match the data under description
Work The theory must be able to explain what is happening, make relevant predictions and explanations
Relevance The theory is useful and relevant for the area under consideration – it is an important concern
Modifiability The theory is open to modification as new data are examined - it is never finished or 'correct' but always open to redefinition

'Fit' is difficult to demonstrate in retrospect, but I am confident that I have undertaken defensible coding of the data I analysed. The clear description of theory in the methodology section should testify to my understanding of the way this should be done in CGT, and the multiple illustrations should provide reassurance this has been applied correctly. My supervisors DH and HSC have audited coding as part of routine supervision (though decisions and interpretations remain my own).

'Work' – this theory provides a practical way of considering peer learning, and the numerous illustrations and outcomes are testament to its potential to explain behaviours seen in peer learning. This includes the ability to explain why students might *not* engage in peer learning, something notably absent in

some other theories. The concept of *Internal Negotiation* is helpful in keeping all of these in play, though future work could address exactly how the different factors are balanced. Furthermore the internal balancing is not observable – it is surmised – it would be fruitful to investigate how the internal element relates to observed behaviours.

Relevance – that this theory is potentially useful is demonstrated in the preceding section on Practical Implications of the Theory. These lessons proceed directly from the hypothesis in the theory. Of course they remain unconfirmed, but this fits the requirement of CGT that the concern addressed by the theory is important for stakeholders – both students and their teachers. Discovering whether this really is relevant will require practical application, which is taken up in the next chapter.

Modifiability – the extensive literature review includes several instances of how the theory has been modified already, such as the usage of the term *Credibility* based on Watling's work (2012). There are multiple opportunities to modify this theory further – these will be discussed in the subsequent section, and serve as further quality evidence.

Other quality considerations – a frequent criticism of grounded theory is the broad pronouncements of generalisability based on relatively modest samples (Watling and Lingard 2012). While I have given multiple recommendations, each of these is contingent on further testing. It may be that the theory gives undue consideration to *Social Risk* for example; this would require empirical studies to test the hypotheses I have made. I must be clear – this theory is taken to be plausible, not 'verified' in any formal way. More pertinently, having spoken with 16 students and analysed one academic year's worth of comments on PeerWise, how can I be confident that this model would be useful for other students? What if there are some students with no interest in *Expected Educational Gain* or whose motivation to take part in peer learning does not relate to the concepts I have developed? This is of course possible, and is one reason why a grounded theory is never 'finished'. Discovering such outliers would lead me to add

new concepts, or modify existing ones to account for these phenomena – hence the theory remains modifiable. Even so, the finding of similar notions in wider literature across multiple fields gives me confidence that if there are untapped concepts waiting to be discovered, they are untapped by other scholars too.

3.9.4 Implications for future work

The theory of *Internal Negotiation* is in effect a series of hypotheses. Each of its component parts raise their own questions about whether they can be verified, or explored more deeply to enlarge on what they mean. For example, we could test whether *Expected Educational Gain* promotes peer learning by correlating a survey designed to measure it with participation in peer learning. We could explore why some learning is considered *Authentic* and others not, and whether training in the *Skill* of *Internal Negotiation* actually improves engagement or experience of peer learning. Likewise we can test whether longitudinal introduction of peer learning does in fact help build *Social Reward* and reduce *Social Risk* and under what circumstances. If *Social Risk* is a problem to be countered, what measures could mitigate it and let students overcome their inhibitions? This may not always be desirable – we know that many students are reluctant to take part in the physical examination of their peers, including for social or religious reasons (Rees *et al.* 2005). Is *Social Risk* something that we should just learn to accept?

The great benefit of developing a theory of this nature is that it automatically prompts questions such as this. In the final conclusion to this thesis, presented in Chapter 5, I will attempt to draw together the results of all the chapters and propose what I consider to be the most valuable next steps.

3.10 Reflections

As a novice in the use of Grounded Theory I have enjoyed developing abilities and expertise in the method and feel rewarded by the fruits of this work. Looking back to my early work I can see how my understanding has evolved – for example the account given in my original MD application does not reflect the same understanding of the method I now have.

I am pleased with the theory I have produced, particularly in the way it has prompted me to explore the wider literature on cooperation, dialogue and conflict. My intellectual curiosity has been satisfied by engaging with new and unexpected fields in an academic way.

From the Pragmatist perspective I think this has achieved what I intended – developing a practical theory to guide preparation for clinical practice – and I feel happy with the choice of Classic Grounded Theory. No doubt other approaches could yield similarly helpful results (I remain sympathetic to the Constructivist approach), but the model I have built does seem to be highly applicable to teaching practice. It is with this in mind that I turn to the next chapter which reports on work to promote peer learning to the clinical context through a project called Peer Practice.

Chapter 4 Peer Practice

4.1 Chapter Abstract

The clinical setting is a promising arena for peer learning. It is where much modern medical education takes place, and most closely reflects the kind of collaboration around real patients required of medical graduates. However it is also a challenging place to learn as the competing priorities of clinician-teachers, social hierarchies and student-staff ratios present potential barriers. Whether peer learning of clinical skills in this environment is effective has not been tested. This chapter presents a study that uses experimental design to assess effects of peer learning of clinical skills in the workplace.

A teaching project called Peer Practice was implemented in the clinical setting. Students would practise clinical consultations in pairs using standardised resources and incentives. The effects of this project were analysed through the lens of a 'practical trial', a real world multi-outcome study. Using a modified crossover design, the impact of Peer Practice on performance in summative assessment was tested, as well as the effects on students' attitudes to peer learning, frequency of participation in peer learning, and their views of the Peer Practice itself.

In a class of 241 students, the results were consistent with a small performance gain with the use of Peer Practice (equivalent to a 1/3 mark increase per 40 mark assessment station, $p=0.038$). Students' receptiveness to peer learning increased after Peer practice was implemented, and reported taking part in peer learning more frequently. Students rated the experience highly. All of this demonstrates modest evidence of the benefits of peer learning of clinical skills in the workplace using a project that was highly valued, sustainable and improved receptiveness to future peer learning.

4.2 Introduction

The previous chapters have identified both theoretical benefits and theoretical limitations to peer learning. This chapter appraises the evidence for peer learning in practice, and focuses on the role of same level peer learning of clinical skills in the clinical setting. Several recent reviews have identified a gap in the evidence in this setting. In Tai *et al*'s review of peer learning 'on clinical placements' several studies did report on peers teaching one another clinical skills (Tai, Molloy, *et al.* 2016) but on closer review these appeared to be outside the clinical setting, such as physical examination in a classroom during a clinical rotation (Perry *et al.* 2010) or the use of musculoskeletal ultrasound in a skills lab (Knobe *et al.* 2010). The impact on clinical competence is also not well addressed by the studies in Tai *et al*'s review – only about half go beyond Kirkpatrick level 1 of analysis *i.e.* learner's reaction (Kirkpatrick and Kirkpatrick 2009, Tai, Molloy, *et al.* 2016), and the majority had outcomes based on self-report. Tai concludes that there is a need for 'external assessment and potentially in experimental (i.e. randomised control trial) conditions' (Tai, Molloy, *et al.* 2016, p. 481). Similarly, Tolsgaard (2016) identified several high quality studies in simulators and classrooms that support the benefit of peer learning, and notes

> little is known about how collaborative learning of clinical skills may work in the clinical setting, where social dynamics are changed and opportunities for repeated practice do not always occur (Tolsgaard *et al.* 2016, p. 50)

In sum, recent academic reviews suggest a lack of high quality data on the effects of peer learning of clinical skills in the clinical setting. This chapter will review the literature independently to characterise the apparent gap, and then report on a project – called Peer Practice – that aims to address it.

4.3 Literature Review

This section will appraise the existing literature on peer learning of clinical skills in order to a) outline the current evidence base for same level peer learning of clinical skills and b) identify any gap and provide rationale for this chapter's research.

The search was aimed at identifying all recent and relevant studies on the role of same-level peer assisted learning of clinical skills amongst medical students.

The reasons for focusing on same-level peer learning of clinical skills in the clinical setting has been outlined in Chapter 1. Other authors have already answered questions about whether students can teach more junior colleagues (Burgess *et al.* 2014a). Despite the intended focus on the clinical settings, I have included clinical skills both in laboratory and other non-clinical settings, since the evidence base for workplace settings is said to be small and it was important to confirm a gap prior to proceeding with the project (Tai, Molloy, *et al.* 2016). While the peer learning project described below included students at the same level as one another teaching each other - often called reciprocal or dyad training (Tolsgaard *et al.* 2016) – I also included studies where one specially trained group of student tutors taught another group if they were at the same stage of academic training (e.g. within the same year).

The above reviews and others – identified in a baseline search for 'peer learning' and 'review' in medical educational literature – included older studies such as a small classroom study on peer learning of neurological examination (Lawton and MacDougall 2004) a study on the video examination of peers with feedback (Calhoun *et al.* 1990). The broad findings of these reviews have already been discussed above. In order to focus on new data, I have limited my search to those published since January 1 2008; indeed the majority of the studies referenced in the other

reviews are from that period (Tai, Molloy, *et al.* 2016, Tolsgaard *et al.* 2016, Herrmann-Werner *et al.* 2017).

I took a broad view of clinical skills to include both technical skills (such as venous cannulation or clinical examination) and non-technical skills, defined by Flin as 'the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance'. And include 'situation awareness (attention to the work environment), decision-making, communication, teamwork, leadership, managing stress, coping with fatigue,' (Flin *et al.* 2008, p. 1). There are several papers on the peer assessment of professionalism e.g. (Arnold *et al.* 2005); I did not include them in this literature review because they were primarily end of placement evaluations of others' performance during a semester/year and it is not clear how this relates to peers teaching one another directly (Topping 1996).

Some teaching is tutor-led but involves peer feedback as in communication skills teaching where a tutor or simulated patient helps students critique one another's interviews e.g. (Stegmann *et al.* 2012, Hunukumbure *et al.* 2017), Strictly speaking, this would not appear to fit the classic definition of peer learning by Topping (1996). Moreover if these studies were included I would have to consider *any* educational intervention where students commented on each other e.g. flipped classrooms (Luscombe and Montgomery 2016), bedside teaching (Jones and Rai 2015) or problem based learning (Hmelo - Silver 2006). The peer learning in these approaches is doubtless valuable, but since this research project was primarily interested in how students could teach one another (with no teacher present), I excluded these studies.

The final inclusion and exclusion criteria are as follows:

Studies were included if they met ALL of the following criteria

- Report on peer assisted learning
- Participants were medical undergraduates before primary medical qualification

- Articles published since January 1 2008 (date of last search 19th July 2018)
- Published in English
- Studied clinical skills
- Reported new results e.g. student perspectives, results of an experiment, surveys, or other outcomes.

Studies were excluded from this search if they met any of these criteria:

- Review articles without new outcome data
- Described near-peer teaching (tutors across years)
- Reported on 'peer learning' that was in fact facilitated by senior/faculty tutors
- Primarily studies of attributes not meeting the definition of clinical skills above e.g. written knowledge / scientific understanding,

I searched Web of Science Core Collection, supplemented with EBSC host including the ERIC data base and Medline. Included search terms were: student / undergraduate / peer / peer assisted / peer learning / peer tutoring / dyad / reciproca* / cooperat* / collaborat* / skill / consultation / history / examination / clinical education / medical education. This search was supplemented by review of reference lists from identified texts or reviews, and my own reference library.

This yielded some 900 articles. After title / abstract review 108 were selected and abstracts / full texts were screened against the inclusion / exclusion criteria. Many studies were excluded because they were studies of postgraduate programmes (the subjects were qualified doctors), were not in medical education (e.g. physiotherapy, nursing studies), were studies of near-peer teaching, were in fact faculty-led, or did not reference clinical skills (e.g. were studies of anatomy knowledge).

4.3.1 Summary of studies

26 articles were included in the final list: Table 4-A summarises the settings in which the peer learning took place, as well as the general focus of the studies and the clinical skills under discussion. A more detailed summary is found in Table 4-B on the following page. Of the 26 studies, 13 primarily took place in classrooms, skills labs or simulation suites, 9 were based in the workplace, and 4 were in a combination or the two. There is thus a fairly even split of settings for studies of peer learning of clinical skills. Studies in the classroom appear to include a wider range of technical and non-technical skills, whereas workplace assessment tended to be on mostly technical skills such as clinical history taking, physical examination, and technical procedures.

In order to give an overview of the kinds of research being done, the table also divides up studies according to whether they were primarily studies of student *perspectives* and views of peer learning (typically a focus on more 'qualitative' data like interviews, or quantitation of student views by survey), or whether they were attempting to measure *performance* (generally a more 'quantitative' focus on measured scores). Workplace studies tended to have a greater emphasis on perspectives, either enquiring specifically about how skills are learned there, or including this in a wider survey of peer learning in the workplace. Conversely, most studies with 'performance' data (such as scores in an OSCE or standardised assessment of skills) were classroom based, perhaps reflecting practical considerations of randomisation and cohort allocation.

Table 4-A Overview of Literature

Setting	Emphasis on Perspectives	Emphasis on Performance	Skills Being Studied
Classroom n = 13	4*	10*	History and Examination Communication Skills Peer Assessment Resuscitation Ultrasound Technical Procedures
Workplace N = 9	7	2	History and Examination Technical Procedures Clinical Reasoning
Classroom and Workplace N= 4	2	2	History and Examination Ultrasound
** One classroom study included both data on perspectives and performance (*(Basehore *et al.* 2014)			

Table 4-B Summary of Individual Papers

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
(Al-Kadri *et al.* 2013)	How do students approach workplace based assessments ? Includes some peer feedback **Workplace - Perspectives**	students on clinical placement receiving workplace based assessment on history and exam. Thematic analysis of interview elements from various methodologies	Peer feedback seen as less threatening than senior-given feedback though not as reliable	Score 8/11. Qualitative analysis bespoke but reasonably described. Not clear if peer feedback was senior-led. Cursory description of ethics. Supports positive role of students in giving one another feedback.
(Basehore *et al.* 2014)	Can peers mark OSCEs? **Classroom – Performance (and Perspectives)**	115 students undertook an OSCE on geriatric medicine then reviewed peers' videos – comparison with faculty. Survey with free text	Good correlation with faculty (r=0.78) and said to be educationally beneficial in terms of insight into process and future performance	Score 8/11. Well-designed assessment of peers' marking ability, but no evidence for benefit to learning and no power calculation
(Bennett *et al.* 2012)	Can 'mini-CEX' be used to aid reciprocal peer teaching? **Workplace - Perspectives**	Thematic analysis of feedback 40 undergraduates assessing one another with postgrad 'mini-cex' form – a history / examination encounter	Students generally found it useful, but note that around half did not think it was appropriate / useful to be evaluated by peers	Score 6/11. Brief report so data not fully evaluable. No performance data
(Bergeron *et al.* 2018)	Does online peer-peer patient encounter simulation improve OSCE scores? **Classroom - Performance**	206 novice medical students: Comparison between those who used the mobile app <10 times and 10+ times: OSCE score and fail rates. T-tests and linear regression	Those who used the app >10 times had slight increase in OSCE mark (c. 1.5/100) but no difference in fail rates. Minimal effect of number times app used on grade	Score 5/11. Clear risk of selection bias and inappropriate use of 1-sided t-test. Ethics of accessing other students' result not well described Nevertheless app was popular and consistent with slight benefit to use
(Chinnah *et al.* 2011)	Longitidunal views on how peer physical examination (PPE) in	Focus groups (n=20) analysed with thematic framework analysis and follow up questionnaires to	Students felt early years peer physical examination made them	Score 7/11. Low survey response rates (23%) but plausible analysis of focus groups. Peer physical

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
	early years prepared for clinical skills in later years **Classroom/workplace - Perspectives**	wider year group of 114/595 students in final 3 years of medical school	more comfortable and skilled at examination later Majority but not all liked PPE	exam generally accepted and considered good basis for future skills training; small but some students not comfortable with the teaching.
(Chou *et al.* 2013)	Does prior-acquaintance improve the quality of peer feedback in communication skills? **Classroom - Perspectives**	55 student dyads or triads of 1st year students, 37 of whom knew each other from previous study – learning communication skills. Quality of feedback in videoed consultation by participants + faculty	Where a prior peer-learning history exists, feedback is of higher quality – more 'corrective' rather than reinforcing / praising.	Score 9/11. Sensible design and statistics but no power calculation, well blinded to cohort grouping Suggests longitudinal relationships improve feedback quality in peer learning
(Chou *et al.* 2014)	Do peer groups support effective workplace learning? **Workplace - Perspectives**	54 Medical students on first attachment – one group encouraged to form longitudinal peer groups through timetabling . Includes some facilitator-led weekly sessions 'qualitative' analysis of survey, referencing Grounded Theory methods	Peer groups reported to be very helpful for learning clinical skills, interpersonal support and learning. Workplace groups formed in both 'arms' but more structural opportunity in the timetabled group Students did mention some unwanted competition	Score 6/11– reasonable design though details of qualitative method sparse and selection bias likely and representativeness unclear Suggests usefulness of peer groups in clinical settings for learning skills Suggests structure important
(Cushing and Westwood 2010, Cushing *et al.* 2011) [appear to be same study]	Benefits of a formative-OSCE for communication skills, designed and run by students in the same year **Classroom - Perspectives**	Analysis of survey response and focus groups. 78 students (2nd study – similar students + results) Students rotated round patient, candidate and examiner roles and gave each other feedback. Survey and focus groups after the event.	Students valued the chance to practise and got useful feedback. Felt giving feedback particularly helpful, though many would prefer faculty feedback. Some hesitation about criticising colleagues, and difficulty with a long marking scheme	Score 6/11. Not clear how much faculty input present. No data on performance – 'benefits' subjective Supports value of participation in peer assessment of clinical skills, with caveat about **value compared to senior teaching.**

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
(Duvivier *et al.* 2012)	How and why do students learn physical examination out of scheduled teaching? (only partly about peer learning **Classroom/workplace - Perspectives**	Year 1-3 medicals students – survey of learning habits of 875 students and focus groups based on survey results (52 students across year groups) 'constant comparison' qualitative analysis	Regarding peer learning: Peer feedback hampered by uncertainty of standards. Being a patient improves own performance. Effects of peer pressure may diminish with time.	Score 7/11. High response rate (875/972, 90%). Qualitative analysis not clearly described. Ethics cursory. Sets peer learning in context – one of many approaches to learning clinical skills and many other motivators
(Duvivier *et al.* 2014)	What workplace factors influence learning clinical skills? (not focusing on peer learning *per se*) **Workplace – Perspectives**	Qualitative analysis of focus groups (n=32) on first clinical placement References to grounded theory methodology	Not focusing on peer relations, but note that peer hierarchies of 'proactivity' matter where very enthusiastic students 'crowd out' less enthusiastic students	Score 9/11. Design appropriate (details of data analysis scarce) Points to the importance of interpersonal relations between students impact workplace learning
(Heckmann *et al.* 2008)	Can same-level peers teach their colleagues neurology? **Workplace - Performance**	122 medical students in neurology clerkship – randomized to be taught by faculty or trained same-level peers who had just completed the clerkship Statistical comparison of written and OSCE assessment performance	No significant difference between groups in written or OSCE scores, though students considered faculty more competent.	Score 6/11. No power consideration, and details of non-inferiority testing not apparent. Ethics cursory. It is possible to train students to teach +/- improve efficiency.
(House *et al.* 2017)	Can same-level peers teach emergency simulation? **Classroom - Performance**	111 Same-level peers assigned cases to teach their peers in emergency medicine via simulation. Comparison with 65 students taught by faculty.	Examination not different between groups, though those taught by faculty rated their teaching more positively	Score 7/11. Not clear that written assessment is a good outcome for the practical teaching format, and they should test for non-inferiority. Still supports the ability of peers to teach one another clinical skills.

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
		Outcome – performance in written knowledge assessment and survey		
(Hulsman and van der Vloodt 2015)	How do self- and peer- ratings of communication skills compare? **Classroom - Performance**	25 students recorded clinical interviews, then reviewed videos and gave self-assessment and peer-review Statistical comparison of number of comments and type of comment (positive, negative, etc.)	Students gave themselves more negative ratings, and gave their peers more positive ratings even though peers were not present.	Score 6/11. Small numbers with no power calculation and no description of ethics. Findings suggests peers tend to give each other a positive mark even when formative
(Knobe *et al.* 2010)	Can medical students teach musculoskeletal ultrasound? **Classroom - Performance**	Students in 3rd + 4th year randomised to training by faculty (n=76) or same-level peers with prior training (n=75) – comparison of written and practical assessment scores	No statistical differences in scores, and student teachers got better scores than their peers, but students preferred experts.	Score 9/11. Sample size not justified and non-inferiority test would be better. Supports the ability of trained peers to act as teachers even when at the same level of general experience.
(Krogh *et al.* 2014)	Does participating in peer assessment improve performance in resuscitation simulation? **Classroom - Performance**	86 final year students in emergency care simulation. Half randomised to peer assessment during training. Blinded assessment of performance immediately and at 2 weeks with the same checklists as peer raters,	Peer-assessing group outperformed the controls – by c. 1 mark / 25, but no difference at 2 weeks	Score 8/11 High student drop out (c.1/3 of students lost to follow up). Power not shown. Suggests some benefit to peer assessment but not clear.
(Kwok *et al.* 2017)	Does peer-practice with an online tool of fundoscopy improve performance? **Classroom - Performance**	32 volunteer students learning ophthalmology practised for two weeks with peers and online photograph-matching tool. 63 control students did not. Comparison in OSCE assessment	Intervention group had better OSCE performance – more accurate, faster and more confident.	Score 7/11. Effect of time on task – group had extra teaching, and may be selection bias. No power calculation

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
				Nevertheless, does suggest that incentivised peer learning is effective
(Pelloux *et al.* 2017)	Can peer tutors teach central venous catheter insertion? **Classroom - Performance**	Randomized cohorts – 41 instructor led, 32 student led training on central venous catheter insertion. Comparison in a blinded OSCE one week after training	No major differences in terms of performance or outcomes	Score 9/11. Not clear if student-tutors were at the same level. No power; non-inferiority testing not done Supports the ability of trained students to teach peers.
(Perry *et al.* 2010)	Can students teach musculoskeletal clinical examination? **Classroom/Workplace - Performance**	209 Final year students randomly allocated to cohorts. 50 students in one cohort trained in teaching and then taught all subsequent cohorts. Confidence and OSCE performance vs separate control group (n=229)	All students improved over the course. Trainers did better in OSCE in terms of pass rates and raw scores than those they trained or the separate control group	Score 9/11. Random allocation, but sample size not justified. Being a teacher seems beneficial, and being trained by a peer works but non-inferiority testing not done
(Räder *et al.* 2014)	Does dyad practice improve learning of clinical skills and why? **Classroom - Performance**	72 students in pairs (dyads) or alone, learning cardiac catheterisation in lab Mixed methods – quantitative performance data (single-blind) and qualitative analysis of interviews with dyads (but not solo students)	No difference in performance between groups in performance Pairs reported many benefits including collegial atmosphere between peers, overt communication of challenges aiding learning.	Score 11/11. Appropriate design, matching of baseline characteristics / sample size / power calculation. No proven benefit of dyad practice on clinical performance but other perceived learning benefits
(Tai *et al.* 2014)	Describe experience of students using PAL in clinical context **Workplace - Perspectives**	'Mixed methods' – survey of experience and value of PAL, and free text	PAL used for practising skills, learning by teaching, building clinical judgement, interpersonal support.	Score 7/11. Poor response rate to survey (13%) and no triangulation of responses with other data. Apparent benefits to learning. But note students' reluctance to

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
		Year 3 (newly clinical) med students – 54 out of 415 respondents	Significant lack of confidence / resistance to giving frank feedback, especially without formal structures: ¼ of respondents said peer learning encourages 'unhealthy competition'	engage fully in peer feedback, and concerns about 'unhealthy competition'
(Tai, Canny, *et al.* 2016b)	What is the role of PAL in building evaluative judgement (seen as a clinical reasoning skill) **Workplace - Perspectives**	Medical students on 1st year of clinical placement Mixed methods – survey, ethnographic observation, interviews	Peers critical in forming one another's 'evaluative judgement' – supportive, safe space, get good feedback, though trust senior feedback more	Score 10/11. Design sound though 16% response rate to survey low. Supports positive role for peers in a non-technical skill if complements senior-led teaching
(Tai, Canny, *et al.* 2016a)	Identifying opportunities for peer learning in clinical placements **Workplace - Perspectives**	Ethnographic observations and interviews of students on 1st clinical placement 84 hours of observation and multiple interviews with staff / students	Students often use peer learning in both formal tutorial and informal student-led contexts. Trust is required, and having a supervisor present boosts perceived value. Structured format improves usefulness of activity and reduces passivity. Tutors play key role in encouraging this	Score 10/11. High quality design – identifies multiple types of events and follows up observations with clarifying interviews. Emphasises role of tutors in guiding peer interactions, and the way that incentives and structure boost the usefulness and enthusiasm for PAL
(Tolsgaard *et al.* 2013)	Clinical skills - is dyad practice better than singleton practice? **Classroom - Performance**	49 undergraduates learning basic history taking and examination in either pairs or alone Randomised control trial with single-blinded OSCE and confidence ratings	Dyad pairs performed better in summative assessment	Score 10/11 Good power calculation (though seems very high effect size) Good evidence that dyad practice is superior to singleton for novices

Study	Study Aim – **Setting and Focus**	Study Design + Sample Size	Findings	Study Quality Score / Comments
(Tolsgaard *et al.* 2014)	What are medical students' perspectives of dyad practice? **Classroom – Perspectives**	Novice students undertaking dyad practice of history taking and clinical examination as on Tolsgaard 2013. Thematic analysis of 24 survey responses	Students learn by reducing 'cognitive load', and that peers provide good feedback and boost confidence Some interpersonal conflicts (uneven abilities), and concerns about 'half the training time' and that more expert students would not be so keen	Score 7/11. Details of 'constructivist' analysis of survey free text sparse and appropriateness questionable Supports theoretical benefits of peer learning for novice students but uncertain whether this translates to more expert students
(Tolsgaard, Madsen, *et al.* 2015)	Dyad practice of ultrasound **Classroom/Workplace - Performance**	28 final year medical students learning pelvic ultrasound in simulator setting: dyads or alone Assessed by single-blind performance on a real patient	Dyad training was non-inferior, despite students effectively receiving half of the hands-on training time	Score 11/11. Blinding done. Small size but statistically sufficient to demonstrate non-inferiority Paired / dyad practice is as effective and more efficient than solo practice
(Zaidi *et al.* 2011)	Can peer groups use 'Positive Deviance' training to benefit underperforming colleagues? **Workplace - Performance**	High performing students designed a peer-led clinical teaching system for their peers (n=33). End of course 'mini-CEX' and '360 degree' assessment results compared to controls from a previous group (n=27)	Those in peer-trained group did better on Mini-CEX and MSF evaluations than the historical controls.	Score 7/11 No power calculations and concerns re: multiple comparisons without Bonferroni adjustment of p-values. Suggests peers can teach one another effectively.

4.3.2 Overview of Study Quality

Assessment of study quality followed the general principles outlined in BEME reviews (Harden *et al.* 1999) looking at appropriateness of research questions, presentation of methodology, statistical analysis, strength of conclusions *etc.* A formal scoring system derived from another BEME review was used (Buckley *et al.* 2009) with scores out of 11 based on similar principles. In this review the minimum score was 5/11, the maximum 11/11 and median 7.5/11 (see Table 4-B)[2]. Some elements of study quality will be taken up in the discussion below, but as an overview, study quality was often low, mirroring findings in a similar review (Tai, Molloy, *et al.* 2016).

For the studies emphasising perspectives there was poor specification of qualitative methodology: most studies made reference to some form of thematic analysis without detailed description of theoretical frameworks, analysis protocols etc. This makes it difficult to judge whether analysis of the qualitative data has been appropriate, or what conclusions can be drawn (Tracy 2010).

Of the 13 studies where performance was evaluated, only 4 included discussion of study power or justification for sample size (Räder *et al.* 2014, Tolsgaard, Madsen, *et al.* 2015, House *et al.* 2017). This is important because where studies do not include this there is a chance that their 'positive' findings do not reflect real differences between comparator groups on further study (Ioannidis 2005). This is considered to be one of the great challenges for educational research that includes quantitative comparisons (Cook and West 2013). Beyond this there were some other concerns – survey response rates were often very low e.g. <20 % (Chinnah *et al.* 2011, Tai *et al.* 2014): this has implications for sample representativeness. Some statistical methods were questionable e.g. Bergeron *et al* tested whether increasing use of their learning technology would improve final scores by

[2] Buckley et al chose 7/11 as a threshold for 'high quality'. That distinction is not used here since it does not take into account how e.g. a major statistical flaw could fatally affect the study conclusions, even if the other elements such as overall design and ethical aspects were reasonable.

using a *one-sided* Student t-test (Bergeron *et al.* 2018): this approach would not test whether their technology reduced scores, and a two-sided test would be more appropriate (Diez *et al.* 2015). Several studies asked if peer teachers were equivalent to 'experts' but used paired t-tests which were designed to look for superiority, rather than non-inferiority tests (Tolsgaard *et al.* 2017). These caveats should be borne in mind when asking 'what is the evidence for peer learning in general?' because the conclusions in the literature are not necessarily based on high quality evidence. Further details will be considered in the studies below.

4.3.3 Studies that emphasise student perspectives

The studies that focused primarily on analysis of student views included interviews and focus groups exploring students' perceptions of peer learning, how it was helpful or not, what barriers there were, or surveys with similar questions. These studies identified many apparent benefits, with students reporting that they found peer learning helpful for learning skills because they could practise frequently and get quick feedback (Cushing and Westwood 2010, Cushing *et al.* 2011, Duvivier *et al.* 2012, Tai *et al.* 2014), build clinical judgement (Tai, Canny, *et al.* 2016b), and support one another in a collegial atmosphere (Chou *et al.* 2014, Räder *et al.* 2014, Tai, Canny, *et al.* 2016a). These and other benefits are highly similar to the ones summarised in prior reviews of peer learning of various kinds (Burgess *et al.* 2014a, Tai, Molloy, *et al.* 2016).

The studies also demonstrated some significant potential barriers. A frequent finding when students were encouraged to give each other feedback was that students 'diluted' or moderated their feedback to either avoid offending a colleague or because they were unsure of the standard (Cushing *et al.* 2011, Tai *et al.* 2014, Hulsman and van der Vloodt 2015). Some studies also reported student preference for faculty-teaching because it was considered more reliable or helpful (Knobe *et al.* 2010, Bennett *et al.* 2012, Al-Kadri *et al.* 2013, Tai, Canny, *et al.* 2016b, House *et al.* 2017). Despite the interpersonal support mentioned above, a significant minority of students

expressed concerns about interpersonal issues: in one study around a quarter of survey respondents reported they felt that peer learning contributed to unwanted competition (Tai *et al.* 2014), and some were embarrassed about practising in front of people who were not their friends (Duvivier *et al.* 2012). In a study of paired-practice of consultation skills some students also voiced dissatisfaction with 'uneven' pairings where one student was considered more expert than another, leading to decreased efficiency of training (Tolsgaard *et al.* 2014). Such inequalities were also evident in a workplace study of learning clinical skills, where the high enthusiasm of some students discouraged less enthusiastic students from spending time on clinical placement to learn (Duvivier *et al.* 2014). Tolsgaard (2014) found some students felt that paired practice would be most useful at 'novice' stage, but that once basic skills were acquired then working with a colleague would dilute learning efficiency.

Most of the above findings come from interviews and surveys of students who have had some experience of peer learning, but one group took a more 'ethnographic' approach, observing peer learning as it happens in the workplace (Tai, Canny, *et al.* 2016a). This well designed study (quality score 10/11) supplemented observations with student and staff interviews which let them ask how and why peer learning happens in the clinical workplace. It demonstrated a wide range of activities – from formal practice supervised by tutors to informal tutorials and conversations at lunch – and emphasised the numerous opportunities available for peer learning in clinical timetables. Participants emphasised the importance of trust between students, and that a formal structure to learning – such as tutor-guidance or scheduled sessions – improved the perceived usefulness of activities and reduced passivity. Another group put in place such incentives; Chou *et al* (2014) introduced timetabled and tutor-led opportunities for some students on clinical placements and surveyed participants for their views on peer learning at the end of the course. Students formed peer groups in both conditions (with and without the formal structures), but students in the more structured groups tended to meet more frequently and valued the tutor involvement. In the less

structured group students still formed useful peer groups, but occasionally students failed to find a group of peers, and (self) reported that they met less frequently.

One study used focus groups to ask about learning physical examination in unscheduled learning (Duvivier *et al.* 2012). They found that peer learning of clinical skills happens in a range of ways, including free time on the wards or with friends or relatives at home. The many motivations for learning this include studying for summative assessment and the expectation of staff and patients. Like Tai's paper (2016a) it suggests tutors can play a role in providing incentives and structures to encourage peer learning. Similarly, Duvivier *et al* (2012) found that peer feedback was often hampered by uncertainties about what were the standards expected of them, and that they might want an expert present to help form this judgement.

A few studies looked specifically at some of the longitudinal effects on peer learning. Chinnah *et al* (2011) report how early peer physical examination (practising with other students pretending to be patients) may promote performance in later years. They interviewed students who had used peer physical examination in earlier years, who reported that they felt it made them more comfortable with surface anatomy and examination technique that translated into stronger ability with real patients later in the course. Of note, this study also asked if students are comfortable with peer physical examination, and while the vast majority are, a small group have significant concerns and are not willing to examine or be examined. This has been found previously (Rees *et al.* 2005). This raises questions about imposing potentially embarrassing peer learning on unwilling students. It may be that some of this can be overcome by familiarity, as in the structured peer group sessions outlined by Chou et al (2014), but there may be cultural and demographic factors that are not easily resolved (Rees *et al.* 2005).

4.3.4 Studies Focusing on Performance

15 of the studies endeavoured to assess student performance in some way. Several compared training delivered by peers with training delivered by faculty (Heckmann *et al.* 2008, Knobe *et al.* 2010, Perry *et al.* 2010, Zaidi *et al.* 2011, Pelloux *et al.* 2017). For example, Heckman ***et al's*** (2008) study of undergraduates learning neurology divided students into those taught by 'expert peers' who had studied the subject earlier in the same academic year, and those taught by senior faculty. The outcomes included OSCE performance of skills such as examination. They found no statistical difference between groups, though noted that course evaluations suggested students trusted faculty more. As in most of the other 'performance' studies there was no comment on statistical power so it is not clear how much confidence to have in the findings – the findings may not be replicable (Norman and Eva 2013, p. 357). Similarly House and colleagues asked whether students could teach one another resuscitation skills as well as faculty (House *et al.* 2017), and finding no difference argued for the apparent efficiency gains to be had by delegating teaching responsibility to peers. Again the absence of statistical justification of sample sizes leads us to questions the safety of this argument. Pelloux's study (2017) of students teaching central venous catheterisation and Knobe *et al*'s study (2010) of students teaching one another ultrasound had similar results and limitations. Knobe *et al* (2010) did find that students who had been trained to teach their peers did better in the performance assessment (2010), supporting the benefits for 'students who teach' outlined above. This was also identified in a study in Glasgow where the first 50 students at one teaching site were trained to teach the next cohorts of around 150 students about examining the musculoskeletal system; in comparison to a separate group of 229 students taught by faculty there were no differences in end of year assessment (Perry *et al.* 2010), though again student-tutors did better than their peers.

A slightly different approach was taken by Zaidi's group (2011) where high-performing students were selected to role-model good performance and mentor 33 colleagues using a technique called 'positive deviance'. In

contrast to the above studies they found that peer-trained students did better than the 27 students undergoing standard training.

In addition to the usual statistical power / sample size concerns, this study also represents the concern about 'time on task'(Cook and West 2013) where improvements may be due to the effects of extra teaching, rather than on the extra value of peer-learning *per se.* This time on task consideration is also at play in studies that looked at the effect of incentivising peer-teaching. In one study, researchers examined the effects of an online imaging matching programme to aid the skill of retinal examination in ophthalmology (Kwok *et al.* 2017). 32 students who volunteered to take part in the programme were more accurate and faster at identifying retinal photographs than 63 students not involved in the programme. Power-calculation issues notwithstanding, it seems plausible that encouraging extra training results in improved performance. Another study tested the effect of an on-line application to help students practise for OSCEs with their peers using virtual cases (Bergeron *et al.* 2018). Students would work together to assess an online patient. All students in a year group were invited to use the application, and researchers compared usage rates with end of year assessment performance (it is not stated whether student-authors of the technology could access the results of their peers, but ethical approval was given locally). Students who had used the application >10 times had slightly better performance than those who had not (66.9% vs 65.5%, p=0.04, group sizes not reported) though as above this study has statistical issues. If true it would again support the effectiveness of peer learning, even if it does not demonstrate the particular advantages of peer vs. non-peer learning. Note that the concern about whether benefits are due to 'time on task' or peer learning *per se* are not necessarily a drawback – as one ethnographic study shows there is plenty of scope for peer learning to happen and it may be that one of its advantages is in making use of time that cannot be filled by tutors (Tai, Canny, *et al.* 2016a). Still, it does matter if the hypothesis is about testing peer learning vs other approaches.

To exclude the confounding 'time on task', a group of papers sought to isolate the peer-peer element in learning new skills. In an exemplary paper by Tolsgaard (2013) - quality score 11/11 - novice students were asked to learn clinical history taking in either dyads (pairs) or singletons (alone). The sample size was justified using a power calculation based on pilot work, and randomisation and blinding procedures for the end of study testing well described. Students learning as part of a dyad outperformed their colleagues. While not addressing the question of comparison with faculty, the study is important because it lends support to the idea that peer-learning is superior to learning alone.

We should be careful, however – in a similar paper, Rader and colleagues (2014) studied the effect of dyad practice of cardiac catheterisation compared to solo practice, finding no difference. Dyad students reported other perceived benefits, though solo students were not interviewed. Still, even if dyad practice is not *superior* to training alone, it may provide other benefits for teachers. In another study by Tolsgaard and colleagues (2015), students learning gynaecological ultrasound in pairs performed just as well as colleagues who had learned alone (non-inferior), even though dyad students had half the amount of 'hands-on' time with the ultrasound equipment. This kind of efficiency gain may be important for resource allocation and teaching design. This paper also benefits from a formal use of the statistical test of 'non-inferiority' where researchers define what degree of difference they would be willing to accept between one group and another, and test accordingly (Tolsgaard *et al.* 2017). This is probably a better way to check whether peers are in fact 'equivalent' to expert tutors.

4.3.4.1 Peer assessment

Some papers sought to test student performance in giving one another marks for performance of clinical skills. Basehore *et al* (2014) asked whether students could use standardised criteria to assess their peers as well as faculty. 115 students in their geriatric medicine rotation undertook an assessment about patient assessment and their performances were videoed.

After receiving some training in marking, they each marked some of their peers' performances and the scores were compared with the faculty marks: they reported very good correlation (r=0.78) and participants supported benefits in terms of insight into assessment processes and how they might approach future assessments.

One group compared students' views of their own performance in a communication task to their views of one another's performance (Hulsman and van der Vloodt 2015). The 25 participants separately marked their own and their peers' performance in videos of communication skills sessions. Researchers reported a tendency for students to give themselves more negative ratings and their peers more positive ratings, perhaps for fear of causing offence even though the assignment was formative (Hulsman and van der Vloodt 2015).

Work by Chou's group has stressed the importance of relationships between students in supporting peer learning, perhaps because of the ability to overcome the kind of 'fear of offence' Hilsman and van der Vloodt report. They studied the quality of feedback given by student pairs or triads who either knew each other from previous study or had just met (Chou *et al.* 2013). Students with previous acquaintance were more likely to give corrective feedback (that pointed out mistakes) than those who had just met. While this study did not give details of power calculations, the findings suggests that longitudinal relationships are an important variable in behaviours during peer feedback will be given, a conclusion supported by other studies which emphasise the importance of trust developed between participants (Tai, Canny, *et al.* 2016a) .

4.3.5 Studying Performance in the Workplace

A key interest for this thesis is the evidence for the benefit to clinical competence of peer learning *in the workplace*. The reciprocal or dyad/triad approach is thought to be useful because it takes advantage of the natural co-timetabling students at the same level have and does not rely on time-

consuming ‘elite’ training of one group, and may have specific educational benefits based in cognitive and social theory (Tolsgaard *et al.* 2016). Reciprocal training also the subject of the highest quality studies of performance in this review (Tolsgaard *et al.* 2013, Räder *et al.* 2014, Tolsgaard, Madsen, *et al.* 2015).

Of the four studies purporting to assess the performance effect of peer learning in the workplace, 2 included specially trained groups of students who then acted as surrogate tutors for their peers (Heckmann *et al.* 2008, Zaidi *et al.* 2011). In the Heckman paper (2008) and the Perry paper (2010) students were on clinical attachment but in fact teaching appears to be in a non-clinical training session. 1 study took place across two settings where the training happened in a classroom (simulation) but the assessment was a real workplace performance of ultrasound (Tolsgaard, Madsen, *et al.* 2015).

There are thus no studies of reciprocal peer learning where teaching itself happens in the workplace and where performance has been formally assessed. This is a key gap in the literature – the studies on student perspective and the classroom studies suggest that there will be great benefit, but this has not been formally addressed.

4.3.6 Summary of literature review

To sum up all of the above, most studies of same-level peer learning of clinical skills take place in the classroom and report on student perspective or experience. Despite some methodological limitations, insights from the studies focusing on student perspective support the plausibility, perceived benefits, and general acceptability of peer learning. These also identify challenges in most papers, including the potential for embarrassment, preference for tutor led sessions and the need for structure and guidance. The reported benefits and problems mirror those summarised in general reviews of peer learning.

Of those studies that measure performance outcomes, quality is often poor without proper consideration of statistical power or controlling for the effect of

'time on task'. A few well designed studies give reason to believe that peer learning is helpful.

Critically, no studies assessing performance assessed reciprocal training of students by their peers in the workplace. It is thus unproven whether peer learning of clinical skills in the complex clinical environment is superior to alternative forms of training. This is a major gap and confirms the conclusions of other authors on the need for further research in this area (Tolsgaard *et al.* 2016).

4.3.7 Literature Review Conclusion

There are thus pedagogical reasons to think peer learning is effective, practical reasons to think we can make better use of it, and a research gap in asking whether reciprocal teaching in the workplace can improve performance.

4.4 Research aim

Peer learning is widely promoted in medical education, but as I have just demonstrated there is a dearth of evidence regarding its benefits for learning clinical skills in the workplace. One of the purported benefits of peer learning is to promote clinical competence; in the terms of the GMC this includes the ability to perform clinical skills (General Medical Council 2015). One such set of key skills is in clinical history taking and examination: elements of a clinical consultation and one of several areas where recent graduates over-estimate their abilities in comparison with their supervisors (Tallentire *et al.* 2011). I will use the term 'consultation skills'- as a subtype of clinical skills - to incorporate history and examination skills. This is an area where students already do some peer learning but report reluctance to give peers constructive critique (Duvivier *et al.* 2012). There is some evidence that peer feedback can be detrimental to academic performance (Ryan *et al.* 2017).

Peer learning of consultation skills therefore represents an area that students, teachers and regulators value it is unclear whether efforts to expand peer learning will have positive or negative consequences. This is thus a suitable subject for study of the benefits of peer learning.

The primary aim of this research was to test whether a programme to promote the reciprocal peer learning of consultation skills in the clinical setting can improve students' competence.

4.5 Theoretical Framework and Methodology

The introductory chapter has already set out the position of pragmatism and the importance of justifying method based on the intended product of research. Since the aim in this chapter was to demonstrate a measurable improvement in clinical competence in consultation skills using peer learning, it is logical to use a framework that relies on the testing of hypotheses. Here I will defend the use of 'practical trials' to achieve this.

4.5.1 Practical trials

A traditional approach to testing the effect of educational initiatives is to undertake some randomised controlled trial (RCT) in a laboratory setting, with some examples described in the literature review (Tolsgaard *et al.* 2013, Räder *et al.* 2014). These approaches have the advantage of controlling variables, isolating confounding factors and demonstrating proof of principle. But there are major drawbacks. Sample size is an issue – since most educational interventions have small or medium effect sizes (Hope and Dewar 2015), large numbers of participants are required to have adequate statistical power (Cohen 1992). Recruiting such large numbers of students may prove difficult. Further, selection and inclusion criteria may introduce population selection bias such that the participants are not representative of the target population (Tolsgaard *et al.* 2017). One imagines that students who are relatively less engaged with education in general may benefit most from innovations, but are not willing to volunteer for RCTs. Real clinical workplaces may have multiple confounding factors for RCTs that are not easily controlled such as variations in teaching quantity due to tutor shift patterns and teaching locations, exposure to different patient groups that might influence learning, and varying student-patient ratios that dictate experiences. Finally, the dilutional effects of educational initiatives – the gap between learning and practice – is large and means that patient outcomes may not be demonstrable (Cook and West 2013). This has led some to critique the focus on patient outcomes and advocate for more nuanced

analysis that includes measures of intermediate behavioural markers, and process, contextual and unexpected outcomes (Haji *et al.* 2013).

One solution to these issues is the use of 'practical trials' (Tolsgaard *et al.* 2017). Practical trials are a relatively recent innovation in thinking about researching educational initiatives, and draw on related notions in health care research generally such as 'complex interventions' (Craig *et al.* 2008) based on the notion of Realistic Evaluation (Pawson and Tilley 1997). In a key paper by Tolsgaard *et al* (2017), the following characteristics of practical trials are outlined:

1) Theoretical roots in post-positivist assumptions about the reality and measurability of desired outcomes
2) A focus on real world situations
3) Use of broad inclusion criteria to include representative study populations
4) Measurement of multiple outcomes to study several things of interest to participants, investigators and other stakeholders
5) Longer term follow up to capture both positive and negative effects that may evolve over time

In order to achieve this, practical trials utilise 'pragmatic' designs such as crossover trials (Pocock 1999), 'stepped wedge' design (Campbell *et al.* 2000), or non-inferiority outcomes where the new approach is no worse for educational outcomes but may have cost or other practical advantages (Tolsgaard, Madsen, *et al.* 2015). These approaches are intended to provide evidence to educators for real application, not simply 'proof of principle' or analogous classroom scenarios that might be identified in more traditional studies.

These principles were applicable to this study. The area of interest was the real world application of peer learning approaches to the learning of consultation skills in the workplace. A design that was able to include a large number of participants would improve study power. Multiple outcomes could help guide educational planners such as the benefit to achievement of clinical competence, the possible effects on working with others, practical challenges of teaching implementation, and the reaction of students. The latter is

particularly important, as I have already noted that students value efficient teaching that meets their priorities (Chapters 2 and 3). The principles of practical trials were therefore used to design the study presented in this chapter.

4.6 Research Questions

With this methodology in mind, the research aims above were therefore refined into the following questions to be incorporated into the practical trial.

Table 4-C Research Questions and Justification

Question	Justification
1) Does reciprocal peer learning of consultation skills in the clinical context promote competence?	This has not been well studied in the clinical context and competence is the overarching concern
2) a) How does experience of peer learning affect attitudes to peer learning in general? **b) How does experience of peer learning affect peer learning behaviours?**	Other studies have demonstrated that students have reservations about peer learning – will this improve after further exposure? Will this lead to more (or less) learning with peers?
3) Is peer learning acceptable to students in clinical settings?	Students may resent being asked to work together, perhaps seeing it as a distraction from 'expert' teaching and the teaching itself may prove unpopular or impractical

I will next discuss the design of the study, and return to this list with the outcomes that will be used to answer these questions.

4.7 Methods

4.7.1 Setting and participants

The curriculum structure has already been described in detail in Chapter 1. Briefly, the medical degree is a 6 year undergraduate course. I introduced the peer learning into Year 4 because this is the first year where students are 'full time' in clinical practice and so really immersed in the workplace where we can address the literature gap. There is some evidence that a degree of familiarity with practical skills is helpful for giving feedback (Calhoun *et al.* 1990), and students in Year 4 have had introductory courses on clinical history and examination earlier in the curriculum.

All year 4 students rotate around 8 subject modules, 4 in each semester. I selected four modules for development: Cardiology, Respiratory, Gastroenterology and Orthopaedics. I chose these because a) they were deemed to represent 'core' clinical topics and b) they were distributed such that all students would undertake 2 of these subjects in each Semester (important for the crossover effect described below).

Students are allocated randomly to the module groups so are expected to be evenly distributed in terms of prior learning, experience and ability.

I focused on clinical skills in history taking and physical examination because these are core skills for doctors and something students have often done themselves in the workplace (Duvivier *et al.* 2012, Tai *et al.* 2014). It therefore seemed plausible that students would be open to peer learning of these skills and would understand the principle of the task.

4.7.2 The Peer Learning 'Intervention' - Peer Practice

The teaching intervention has two main components summarised here:

Common Criteria - Prior to introducing the project to Year 4 I developed an agreed understanding of what constitutes a good history and examination in each of the four clinical subjects under study

Peer Practice – a package of resources, opportunities and encouragements to take part in peer learning, comprising:

- The Pebble Pocket mobile app
- Timetabling changes
- Promoting and incentivising peer learning at class teaching

Appendix 4 includes the evidence base for design decisions and development of resources. The design and format was based on this evidence but also on lessons drawn from the research in Chapters 2 and 3.

4.7.2.1 The Common Criteria

While there are multiple standard texts on physical history and examination, subtle differences exist between the way that physicians prefer to sequence these or what is considered 'core' versus 'optional', leading some groups to document local guidelines on what is the agreed standard (Nikendei *et al.* 2016). A local version was created, called the Common Criteria. I began by establishing agreed checklists for what comprises history and examination in the four modules (subjects) – Gastroenterology, Cardiology, Orthopaedics and Respiratory medicine.

I developed the Common Criteria in close consultation with the lead clinicians who teach each subject ('module organisers'). This was important to ensure that the Criteria were approved by the people students report to, and were consonant with the final summative assessment that module organisers produce at the end of the year. This recognised the potential for minor discrepancies between physicians regarding the 'right' way to examine e.g. the abdomen. Students could be reassured that if they followed the Common

Criteria they would not be sanctioned in assessment i.e. there was no conflict between the Criteria and the summative marking scheme. It was made clear to students that the Criteria were not identical with the summative mark schemes however – in particular history mark schemes often carry extra points for exploring the subtleties of one particular symptom. See Appendix 5 (sub Appendix 1b) for an example of the Common Criteria rubric. These Common Criteria were available to all students from the beginning of Year 4. This was important for the crossover design described below.

4.7.2.2 Peer Practice

Pairs or small groups of students would use the Common Criteria - to practise consultation skills - history taking and physical examination - in the four modules. This is reciprocal tutoring: in a typical scenario two students would be timetabled to spend time together on the ward where one student would take the patient's history or perform the examination while being observed by their peer. The peer would use the Common Criteria to assess the candidate's performance and use this as the basis for review and a feedback conversation. Records of the encounter could be reviewed for future development. This process is summarised in Figure 4-a.

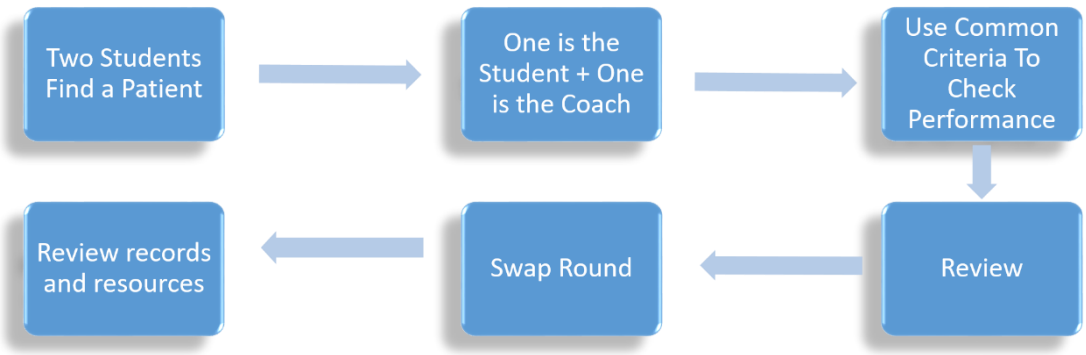


Figure 4-a How Peer Practice Works

4.7.2.2.1 The Pebble Pocket App

Peer Practice relies on resources, opportunities and incentives to undertake this kind of peer feedback. The Common Criteria were available in paper and pdf format, but to increase ease of use a mobile app was developed.

I converted Common Criteria into a mobile app on a programme called Pebble Pocket. Pebble Pocket is developed by Pebble Learning (Telford, United Kingdom) and allows users to have a collection of electronic forms available for completion at any time on their smart phones with or without internet access. This provided a mechanism for ticking off which aspects of performance were and were not completed. The structure of the form includes prompts for critiquing one's peer and saving the records for later use on a desktop computer platform. A screenshot of the app interface is illustrated in Figure 4-b.

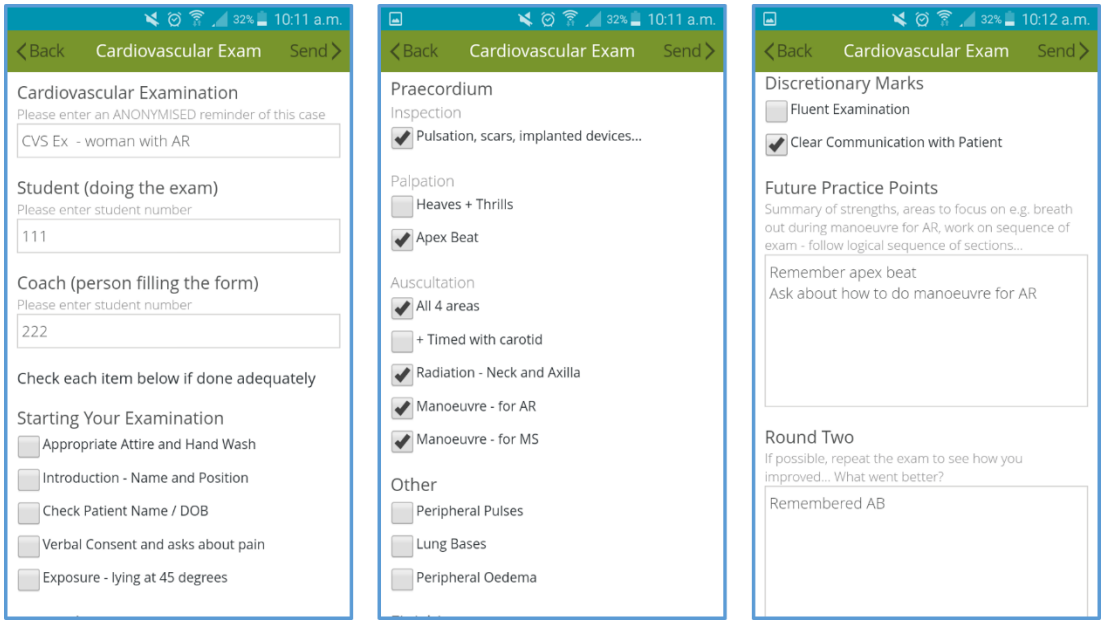


Figure 4-b Peer Practice App Screenshot

4.7.2.2.2 Opportunities for Peer Learning

I adapted each of the 4 modules' schedules so that there were prompts and encouragements to use Peer Practice throughout the course. For example, in Cardiology whenever students were attached to a ward they were asked to undertake a Peer Practice encounter, and in Gastroenterology each week's timetable had one scheduled slot for a suggested student pairing. For some modules e.g. Respiratory / Orthopaedics each student received an individualised timetable depending on the team they were with: these

students were encouraged to use the app throughout their attachments both at induction sessions, tutorials and reminder talks later in the attachment.

4.7.2.2.3 Promotion and incentives

At the start of the semester I presented all students with an introduction to Peer Practice including the rationale for Peer Learning and the way this could be done using the timetable and app. All students received this talk even if their current subject was not involved in the Peer Practice project. This was followed up every 4 weeks at whole class teaching until the end of the semester. Further, the online resources for each subject were updated so that Peer Practice was prominently displayed on the website with links, help sheets and videos explaining how to do Peer Practice. Written guides and videos gave advice on how to have a conversation with a peer about their performance, including principles of feedback and dialogue.

4.7.2.3 Summary of Peer Practice

Peer Practice was thus designed using available evidence on peer learning that included resources, incentives and opportunities to practise consultation skills with one or more fellow students with an emphasis on clinical settings. It was aligned with the standards expected in summative assessment and available to all students in Year 4.

4.7.3 Crossover design

Crossover trials are a way of discerning effect of an intervention by ensuring that while all participants have the 'intervention' they have it in a different order. They also address concerns of fairness since all participants end up having the benefits (or burdens) of the intervention to the same degree. This was considered important so that no students were disadvantaged by unequal access to resources. Other benefits include improved statistical power (each student acts as their own control) and potentially broad inclusion of whole cohorts e.g. all of the physicians at one site (Tolsgaard *et al.* 2017).

The traditional crossover design is factorial e.g. the AB/BA approach where group one has treatment A then B and group two has B then A (Pocock

1999). This is illustrated in Figure 4-c. The arrows in the figure show measurements taken before any treatment (1), after the first treatment (2) and after the second treatment (3). By analysing how these measurements vary between the two groups, you can discern which treatment is more effective (Pocock 1999). Such designs have been frequently used in education for example in teaching clinical skills (Lawton and MacDougall 2004).

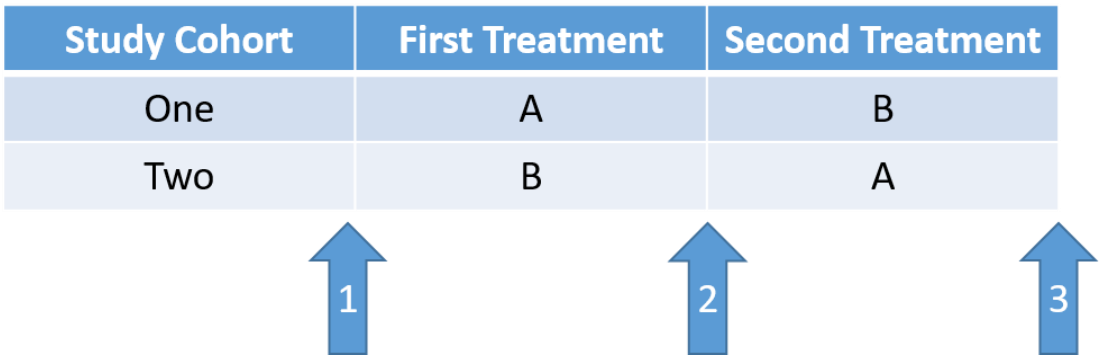


Figure 4-c Traditional Crossover Design

A drawback to that design is the requirement for 'washout periods' – for example if Treatment A is a drug it should have left the participant's body by the time Treatment B starts. This is clearly a problem in educational research as the 'washout period' for an educational intervention may be lifelong. This would be the case for something such as Peer Practice: students could not 'unlearn' the peer approach to consultation skills in any given subject.

To overcome this I modified the design to achieve a crossover *effect* shown in Figure 4-d. Two cohorts of students took the subjects in different orders – Cohort 1 take Cardiology & Respiratory in Semester 1, and Orthopaedics & Gastroenterology in Semester 2. Cohort 2 took the subjects in the opposite order. In Semester 1, all students had standard teaching - they had access to the Common Criteria but were not specifically incentivised to do peer learning because the app was not yet available, the timetables not modified and the specific incentives and encouragements not rolled out. In Semester 2 Peer Practice was rolled out to all students in the four subject as outlined above.

The crossover effect is thus that there was a cohort of students who have undertaken each subject *without* Peer Practice (all students in Semester 1) and a cohort who are undertaking them *with* Peer Practice (all students in Semester 2). It is therefore possible to see how OSCE performance varies for example between exam performance in Semester 1 Cardiology and Respiratory (Cohort 1, no Peer Practice) compared to Semester 2 Cardiovascular and Respiratory (Cohort 2, with Peer Practice) – see Figure 4-d.

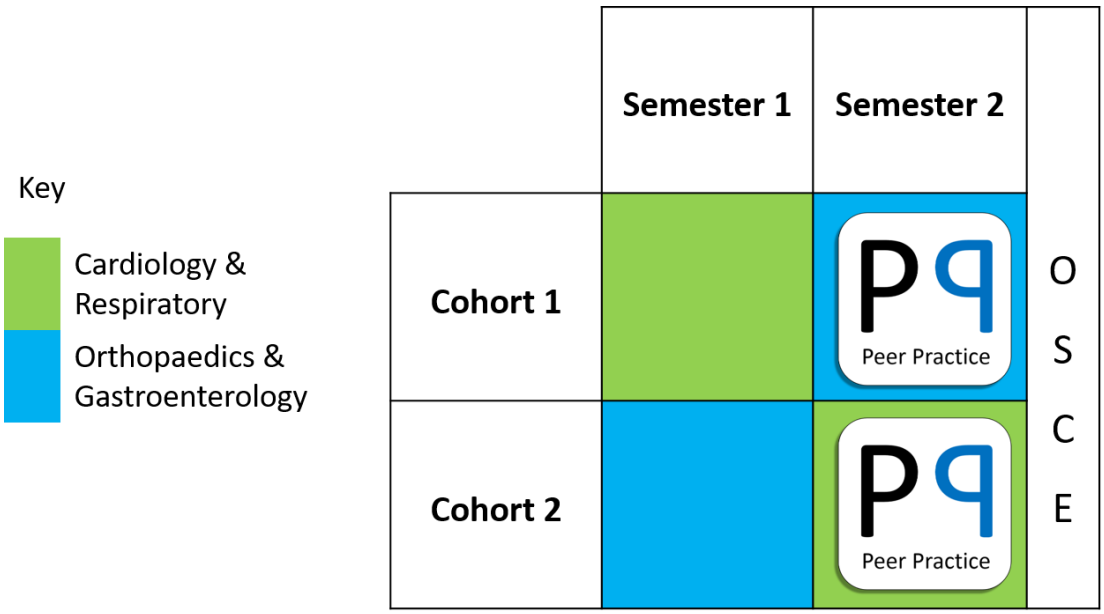


Figure 4-d Crossover Effect

To help ensure that any impact of Peer Practice was not simply due to students being aware of what was expected in the end of year assessment, the Common Criteria were advertised and available from the start Semester 1. This design is not perfect. The critique of its limitations – such as the availability of pre-testing and possible order effects – is taken up in the discussion section of this chapter.

4.7.4 Outcome Measures

Data collection choices were dictated by the research questions given in Table 4-C above.

4.7.4.1 Question 1) Clinical Competence

Clinical Competence was assessed by looking at scores in the end of year summative assessment, the Objective Structured Clinical Examination, OSCE. OSCEs are a well-established method of assessing clinical competence (Harden and Gleeson 1979). OSCEs allows for summative assessment of practical skills such as history taking, clinical examination and communication skills, and allows psychometric assessment of test reliability and validity (Pell *et al.* 2010). Standard-setting is used to ensure all students are treated fairly even where the stations they encounter differ. OSCEs are widely used by UK medical schools as part of assessment of competence according to GMC frameworks: the OSCE therefore seem appropriate as a marker of competence in this setting.

In Year 4 all students undertake an end of year summative OSCE in all of the subjects under study. I used that as a marker of attainment for all students, and use the crossover effect to look for differences depending on the effect of exposure to Peer Practice.

Our main outcome measures for this was comparison of subjects studied with and without Peer Practice i.e. Semester 1 subjects (without Peer Practice) and Semester 2 subjects (with Peer Practice).

This measure and the crossover effect have a number of potential confounding factors that have been considered in the trial design but will be discussed in more detail in the discussion section.

In summary the crossover effect and measurement of performance using the OSCE is a reasonable, practical way of testing for an effect of peer learning on competence.

4.7.4.2 Question 2) Attitudes to Peer Learning and Learning Behaviours

Because I was interested in how experience of Peer Practice would alter views on peer learning in general, I developed a survey to capture this. General reading in the field identified two similar surveys that were plausible candidates for adaptation. Parmelee *et al* (2009) developed a questionnaire to evaluate student perceptions both before and after experience of Team Based Learning, a structured peer learning approach for class rooms (Parmelee *et al.* 2012). Their scale included statements such as 'I have found that teams help me learn course material more than if I just studied alone,' and had sub-scales related to clinical reasoning, professional development and peer feedback. These seem relevant to peer learning in the clinical context. Their scale items had good internal validity (Parmelee *et al.* 2009). I reasoned we could modify the scale to relate to peer learning.

Similarly, the Readiness for Interprofessional Learning scale (RIPLS) was developed for teaching where students from various clinical backgrounds– occupational therapy, physiotherapy, nursing – learn together (Parsell and Bligh 1999). The RIPLS reflects the way that participants may have reservations about the value of interprofessional learning, and a means to test change in perception after experience could be recorded. This has been examined in several settings (McFadyen *et al.* 2005, 2010) and again it seemed reasonable that I could adapt this for my context to gauge similar reservations of the value of peer learning. I added questions about embarrassment based on the notion of *Social Risk* found in Chapter 3.

I adapted the scales to develop a 25-item questionnaire that included questions deemed most relevant to this study. This is shown in Table 4-D (the original scales are reproduced in Appendix 6). This was done in collaboration with my supervisors (who have experience in scale creation and adaptation). To ensure the items addressed questions on how students work with one another (the area of my research interest), references to interprofessional or team-based learning were replaced with references to peer learning.

Table 4-D Peer Learning Attitudes Survey Items

1. Learning with other students will help me become a more effective member of a health care team
2. Patients would ultimately benefit if medical students worked together to solve patient problems
3. Shared learning with other medical students will increase my ability to understand clinical problems
4. Learning with other medical students would improve working relationships after qualification
5. Consultation skills (history and examination) should be learned with other medical students
6. Shared learning will help me to think positively about other students
7. For peer learning to work, students need to trust and respect each other
8. Peer learning skills are essential for all health care students to learn
9. Peer learning will help me to understand my own limitations and how to improve
10. I don't want to waste my time learning with other medical students
11. It is not necessary for medical students to learn together
12. Clinical problem-solving skills can only be learned from senior teachers
13. Shared learning with other medical students will help me to communicate better with patients and other professionals
14. I would welcome the opportunity to learn clinical medicine with other students
15. Peer learning will help to clarify the nature of patient problems
16. Peer learning before qualification will help me become a better team worker
17. I have found that working with other students has helped me become better at problem solving
18. I have found that students make good clinical decisions
19. Discussions with peers have improved my ability to think through a problem
20. I have found that my peers have been fair in judging my skills, knowledge or performance
21. I have found that peer feedback motivates me to work harder
22. I have generally liked the use of peer feedback as part of my learning experience
23. I have found that peer feedback motivates me to work more collaboratively
24. I have found it easy to give feedback to my peers
25. I have found it embarrassing to get feedback from my peers

Frequency of use

In the **last 4 weeks**, how many times do you think you have taken a history or performed an examination in each of the following circumstances?

0 // 1-3 // 4-6 // 7-9 // 10+

26. With real patients with a tutor/doctor present
27. With real patients on your own
28. With real patients with another Year 4 student
29. With another student/friend acting as patient with no tutor/doctor present

Other settings (please specify)

I added some extra questions about peer-learning behaviours (namely the frequency of peer learning in several contexts) to help gauge whether students become more likely to engage in peer learning after introduction of the Peer Practice project. I also collected information from the mobile application Pebble Pad's servers though Pebble Learning. This let us look at how often records were saved on the devices, and when it was being used.

This new Peer Learning Attitudes (PLA) questionnaire was piloted with another set of students in Year 5 and minor refinements made. This survey was then distributed to Year 4 students before Peer Practice – at the end of Semester 1 - and after Peer Practice – the end of Semester 2. This would then gauge any change in perspectives caused by the project. I invited students to respond to this survey by electronic advertisement on the school website and by face-to-face announcements at the end of lectures. Participants could choose to enter a prize draw for a moderate value voucher.

4.7.4.3 Question 3) Acceptability of Peer Practice to Students

This evaluation survey aimed to identify the acceptability of Peer Practice as an educational experience, and to record some of the learning behaviours associated with it. This questionnaire was developed by consensus discussion between me and my supervisors (the items are shown in Appendix 8). Questions included student views of Peer Practice's overall usefulness, the way it the Common Criteria and Pebble Pocket App were used and any technical or unexpected challenges that were encountered. Free text boxes were included for queries and other comments. Again participation was encouraged through the use of a prize draw.

4.7.5 Statistical Analyses

I planned and carried out all analyses using the programme R Studio version 1.1.453 (R Core Team 2018). My supervisors (in particular Dr Hope) assisted with checking my work and giving technical advice as required.

4.7.5.1 OSCE data

Since the stations for each module will have slightly different difficulties, pass marks and components, comparison of mean marks would be difficult. To overcome this, I used *Z* scores – the number of standard deviations the student's score differed from the mean (Wang and Chen 2012, Diez *et al.* 2015, p. 129). This allows comparison between stations since I could quantify how students did compared to the *average (*mean*)* for each station. For example if a student in one station got a Z-score of +1 (one standard deviation above the station mean) they would have done well compared to their peers, regardless of station difficulty. If another student on another station got a Z score of -1 (one standard deviation below the station mean) they would have scored below average compared to their peers, regardless of station difficulty. These Z-scores can be compared with one another: the first student would appear to have done better. Of course this appearance needs to be formally tested – I assessed statistical differences between groups with the two-sided Student *t-test,* taking a *p*-value of <0.05 as significant.

4.7.5.2 Power calculation

A similar study of peer learning of consultation skills in the classroom setting showed *large* effect sizes (Tolsgaard *et al.* 2013). Using historical data from the previous Year 4 OSCE, the computer program G*Power v 3.1.9.2 (Faul *et al.* 2007) was used to assess the required sample size in each group to have an 80% chance of detecting a *moderate* effect size and found I would need 64 students in each group. In practical terms this medium effect size would be the equivalent of a 1 mark out of 40 (2.5%) increase in score for each station (the spread of scores is fairly narrow) and would therefore have genuine practical impact.

The year group under study had 241 students, and given the crossover effect this means there are 241 students in each comparison group i.e. 482 'students' overall. I therefore could be confident in detecting a medium or large effect size i.e. a difference in OSCE marks of at least 2.5% (1 out of 40 per station).

4.7.5.3 Peer learning attitudes

As shown in Table 4-D, each statement required students to state the degree of agreement on a 5 point scale from Strongly Disagree to Strongly Agree. I converted these to a numeric scale where 1 was Strongly Disagree and 5 was Strongly Agree. Descriptive statistics and graphs compared answers before and after Peer Practice. I checked responses for the presence of a 'scale' (are all the questions gauging a single measure of 'enthusiasm for peer learning'?) using Cronbach's alpha. Linear regression was used to compare pre- and post-mean scores. As in the analysis of OSCE marks, the sample size was sufficient to detect a medium or large effect size on the change in peer learning attitudes.

Note that there is some controversy about analysing Likert scores in this way. In brief, some statistical tests are designed for use with 'parametric' or continuous 'interval' data (such as measures of height) where we can expect a classic bell-curve or normal distribution. Some tests are designed for 'non-parametric' data that is grouped in categories and not expected to show normal distribution. An example would be 'ordinal data' like education level where categories such as primary, secondary, university and postgraduate education are ordered but not necessarily continuous. A question arises – can tests designed for parametric / normally distributed data be applied to non-parametric data? Likert scales are a case in point. For convenience, Likert scores are often converted from a 'Strongly Disagree - Strongly Agree' ordinal scale to a '1 to 5' interval scale but it is not immediately apparent that this is legitimate (Jamieson 2004). Nevertheless, the practice is commonplace and statistically justifiable. For *t-tests*, if sample size is larger than about 30 per group (as in our study) the distribution of data is less

critical due to a mathematical property called the Central Limit Theorem (Norman 2010, Diez *et al.* 2015, p. 177). For linear regression, many studies have examined whether data that is not normally distributed biases the results: they found that it makes little difference (Norman 2010). Therefore the approach used here is reasonable.

In the Peer Learning Attitudes survey, students also reported the frequency with which they had practised history and examination under various conditions e.g. practising with a peer and a patient present (see Table 4-D). I performed Chi-square tests for each of the 5 conditions to test for changing behaviour. Bonferroni correction was applied to adjust the *p*-value threshold to 0.01 – see Dunn (1961) as discussed in Hope & Dewar (2015).

4.7.5.4 Acceptability data

Since there were no comparison groups, I only used descriptive statistics and a narrative synthesis of free text comments.

4.7.6 Summary of Research Questions and Outcome Measures

To summarise the above, Table 4-E shows the Research Questions and the outcome measures used to answer them.

Table 4-E Questions and Outcome Measures

Question	Outcome Measure
1) Does reciprocal peer learning of consultation skills in the clinical context promote competence?	Crossover Effect and OSCE scores
2) a) How does experience of peer learning affect attitudes to peer learning in general? **b) How does experience of peer learning affect peer learning behaviours?**	pre- and post-Peer Learning Attitudes survey Data from the Pebble Pocket App
3) Is peer learning acceptable to students in clinical settings?	Peer Practice Evaluation

4.8 Ethical issues

The principles of ethics were described in chapter 3 in terms of autonomy, beneficence (including non-maleficence) and justice (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979). Regarding the ethical principle of beneficence, the purpose of the study is to promote student competence and ultimately the interests of patients. Nevertheless, there are potential threats to student welfare and I took the following steps to address them.

4.8.1.1 Peer learning could be upsetting.

Participation in peer learning could lead students to become embarrassed in front of their peers, patients or other colleagues. I addressed this by efforts to reduce the stakes of participation. Working in pairs or groups was encouraged, timetabled and routine but not formally required – students who were particularly concerned could therefore opt out. This also respects their right to autonomy. Since a degree of peer learning is already an element of current teaching, existing support arrangements for students who become upset - and methods for reporting unprofessional behaviour - are already well established in the institution.

4.8.1.2 Unequal treatment.

This issue relates to the principle of justice. If one group of students receives a new educational intervention that another does not, one group may therefore benefit or suffer compared to the other, particularly if the other group receives no teaching. This concern for fair treatment was addressed as follows. First, given the absence of compelling evidence favouring peer learning in the clinical setting, I considered studying a module with or without Peer Practice to be viable alternatives – there is ethical equipoise between the groups. Those who studied a subject without Peer Practice would continue with the traditional informal peer learning and standard teaching in existing schedules. This is not a placebo. Second, all students have access to the Common Criteria for all modules throughout the year – it is just the formal peer learning element that differs. Third, each student does Peer

Practice in 2 out of 4 possible modules. While the combination is different between student groups, each subject is weighted the same in summative assessment. If Peer Practice helps, it helps all students in 2 subjects, and vice versa if it impairs performance. Further, allocation to each group is random so there is no prejudiced distribution of when Peer Practice is used. All students have access to the App with Common Criteria for all subjects from Semester 2 so again this is fair resource distribution. This is balanced against the confounding factor of 'leak' where intervention groups do not have completely different experiences, but is considered inevitable given the nature of the project. I could not control access to an open source peer-led initiative that is designed to be used *ad hoc* in any setting.

4.8.1.3 Risks to Confidentiality

To preserve student confidentiality, all data was stored securely and where possible in a de-identified manner. Survey responses were anonymous whether by paper or electronic submission, and prize draw contact details were sent in separately from survey responses. OSCE scores were de-identified by administrators. A strict data protection policy was used to prevent any returns of information being accidentally distributed (see Appendix 2). All data were stored on an encrypted password protected drive and password protected files. Paper survey forms were locked in a secure cabinet and destroyed after electronic data entry.

4.8.1.4 Consent

Consent was achieved through the voluntary nature of participation, advertising and briefing sessions to provide information, and descriptions of the way data would be used in research. As is standard in our institution, medical students have given their consent to use of routinely collected educational data (such as summative assessment marks) in research. Questionnaires included statements that completing the survey gave consent for use in research and publication.

4.8.1.5 Ethical Approval

This was approved by the University of Edinburgh College of Medicine and Veterinary Medicine Student Ethics Committee. The complete proposal with amendments is included in Appendix 5.

4.9 Results

4.9.1 OSCE data

Out of 241 students in the year, 233 sat the OSCE. There are thus 233 students in each arm of the crossover design. Figure 4-e shows the mean Z scores for students for subjects they studied without Peer Practice (Semester 1 subjects) and with Peer Practice (Semester 2 subjects). The boxplot indicates the spread of scores (the box contains 75% of all scores with the central band representing the median score and the limits of the vertical lines including 95% of all scores (McGill *et al.* 1978). Tested by Student *t-test*, there was a small improvement in OSCE scores when students had studied the subjects with Peer Practice compared to when they had studied them without Peer Practice. With Peer Practice the mean Z score was +0.07 (95% confidence interval -0.02 to +0.17) and without it the mean Z score was -0.07 (95% confidence interval -0.17 to + 0.03). The difference was statistically significant (*t = -2.061, p = 0.0399)* and the effect size *d* was 0.19 which is considered small (Cohen 1992) and equivalent to a 0.3 mark (0.75%) increase in OSCE performance where stations are scored out of 40. I did not predict that the study was powered to detect this small effect. In a post-hoc power analysis, 439 students would have been required in each arm to have an 80% chance of detecting this.

The pass mark for the examination as a whole was 252.44/400 marks (standard error of the estimate = 11.43) including the Peer Practice stations and the others, equivalent to a Z score of -2.50.

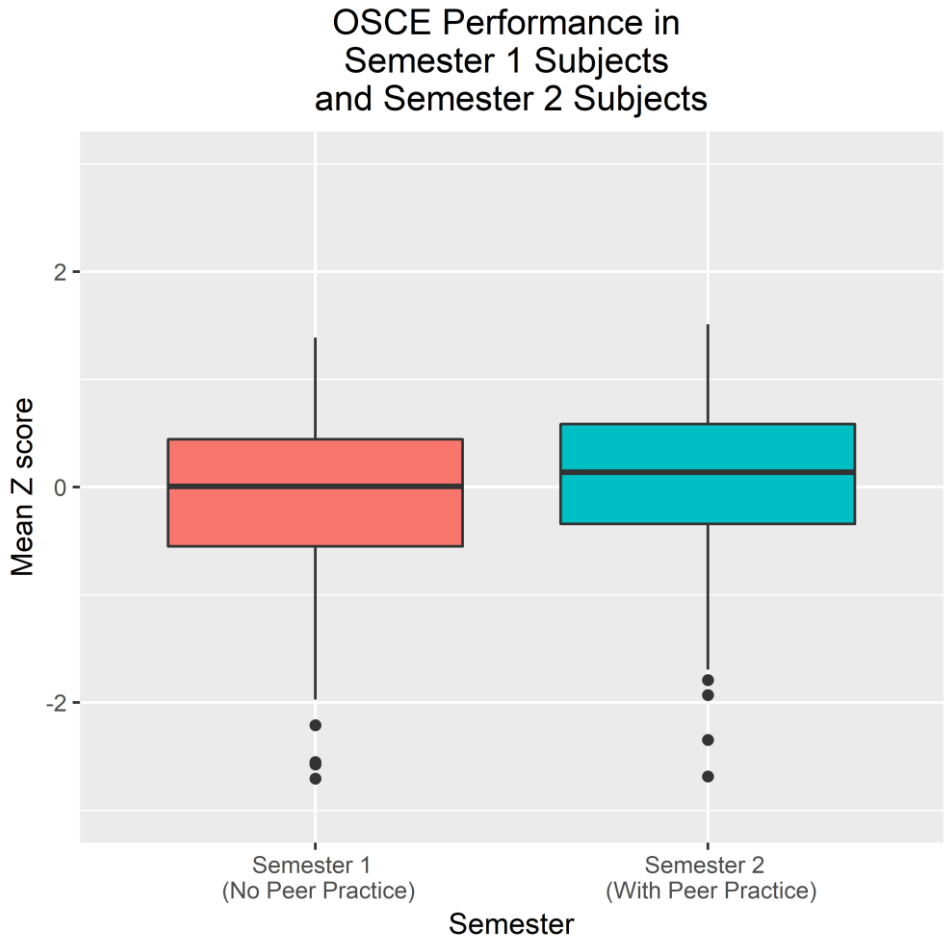


Figure 4-e OSCE Performance

4.9.2 Peer Learning Attitudes Survey

Out of a total of 241 students in the year, 85 students completed the baseline survey and 156 students completed the Post-Peer Practice survey, representing response rates of 35% and 65% respectively.

Complete graphs showing the distribution of responses are included in Appendix 7, but an illustrative selection is shown in Figure 4-f and Figure 4-g). For each graph 1 represents Strongly Disagree and 5 Strongly Agree.

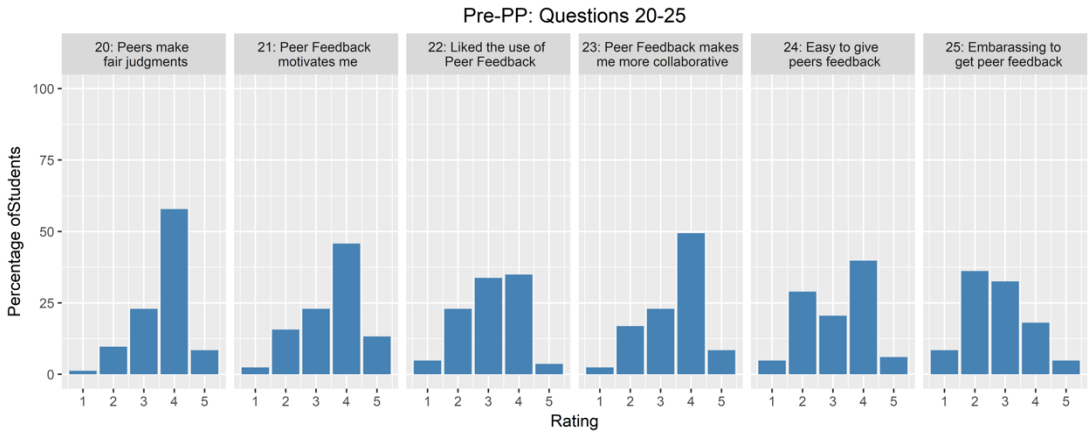


Figure 4-f Questions 20-25 Before Peer Practice

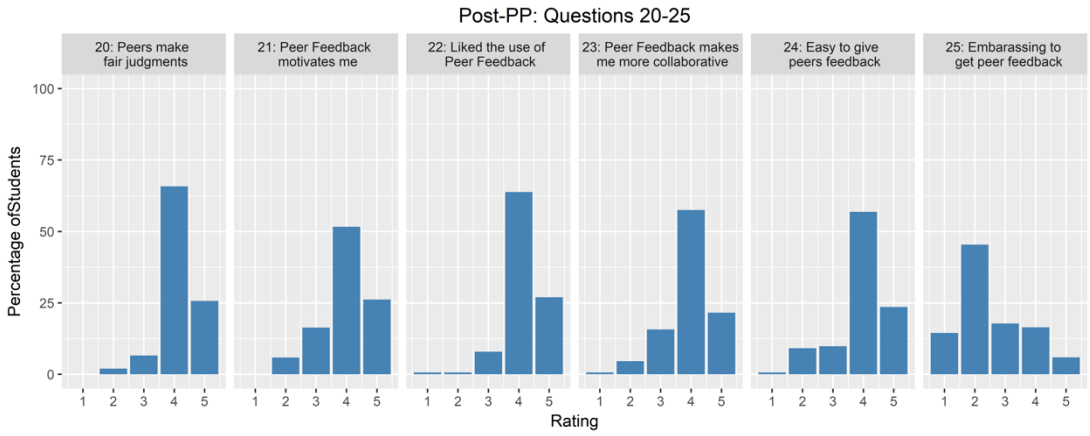


Figure 4-g Questions 20-25 After Peer Practice

In general the responses to all questions were fairly positive with the majority of students favourable to peer learning. For example in question 22, after exposure to Peer Practice more than 90% of respondents agreed or strongly agreed with the statement 'I Liked the Use of Peer Feedback'. Despite this, a minority were neutral or negative about several aspects – in the same question 22, around 25% disagreed or strongly disagreed with the statement before Practice (Figure 4-f). Similarly, many students reported feelings of embarrassment when undertaking peer learning (Question 25 in Figure 4-f and Figure 4-g).

Inspecting all of the graphs, there appears to be a slight positive shift in the perceptions of students towards peer learning, but to establish whether this was true, all the pre-and post-Peer Practice survey results were pooled as follows. First, Cronbach's alpha was calculated to check whether the survey could be considered a 'scale,' where students were in effect answering questions according to a single measure analogous to 'enthusiasm for peer learning' - or some other global rating. There was very high internal consistency for both the pre-Peer Practice survey (alpha = 0.89) and the post-Peer Practice Survey (alpha = 0.91) i.e. all of the questions could be considered to be aspects of the same unidimensional scale.

The mean 'score' according to Likert ratings of each statement was calculated for both Baseline and Post-Peer Practice cohorts Figure 4-h. 'Negatively' worded statements such as Q25 were found to correlate negatively with the other scores and were inverted (i.e. Likert 5 became Likert 1).

The mean score for the Baseline cohort was 3.81 (SD= 0.42, range, 2.72 to 4.72, 95% confidence interval 3.72 to 3.91), and for the Post-PP cohort 4.11 (SD 0.39, range 2.32-5, 95% confidence interval 4.04 to 4.18). Linear regression found a statistically significant difference (p<0.001) with an adjusted R-squared value of 0.1 indicating a small-medium effect size (F value 27.79, df=222, beta 0.297). Pre-planned power calculation suggested there were enough respondents to detect at least a medium effect size, and

post-hoc calculation confirmed that the actual sample size would be expected to be sufficient to detect this.

Note there is a significant outlier in the post-Peer Practice group (dot below the boxplot); inspection of this student's survey return suggests the entries were not genuine (they entered 'disagree' for every question whether positively or negatively worded)

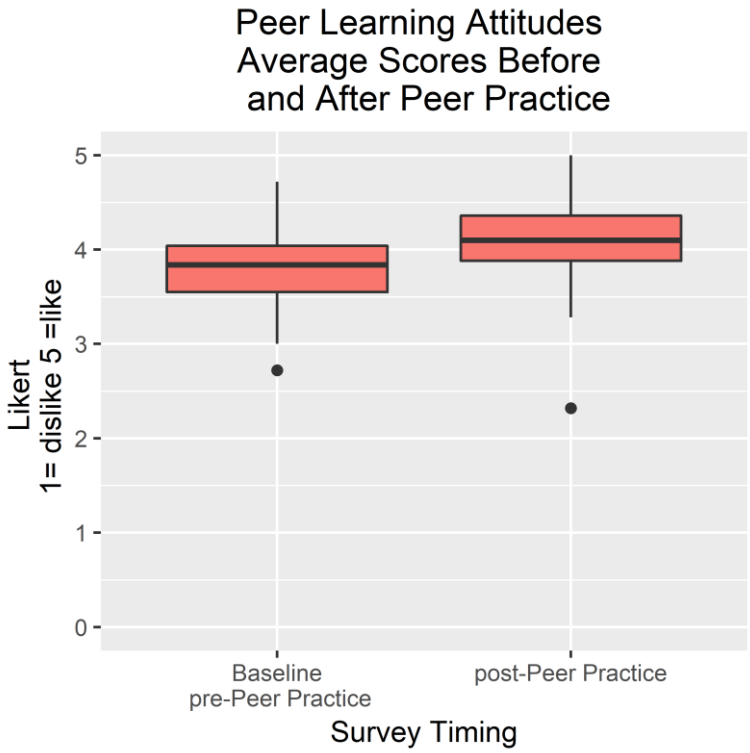


Figure 4-h Peer Learning Attitudes Before and After Peer Practice

4.9.2.1 Frequency data

The Peer Learning Attitudes survey also included data on how often students performed histories or examined patients in various contexts over the 4 weeks preceding completing the survey both before Peer Practice (Figure 4-i) and after Peer Practice (Figure 4-j). 'NA' means no responses were entered by students. While there is no change in the frequency with which students practised this with Patients and Doctors, Patients Alone, or with Patients and Peers (data not shown), there was a statistically significant increase in the frequency with which they practised with Peers Alone (p=<0.001).

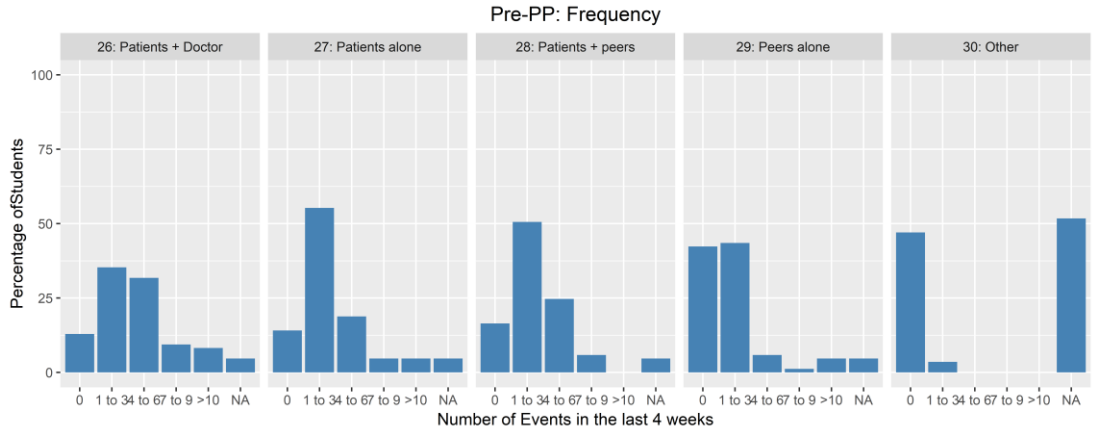


Figure 4-i Frequency of Practising Consultation Skills Before Peer Practice

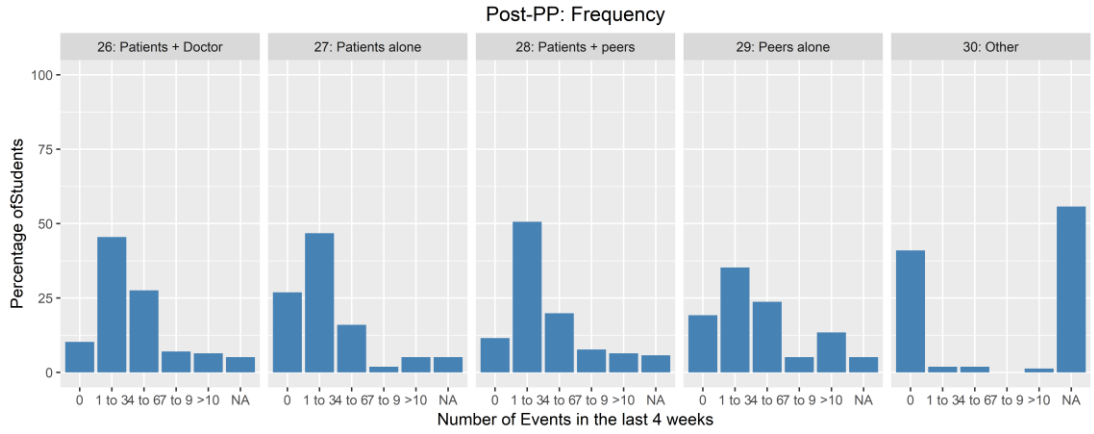


Figure 4-j Frequency of Practising Consultation Skills After Peer Practice

Figure 4-k shows the frequency of Peer Practice records being saved on the Pebble Pocket Mobile App. Usage increased markedly from week 10 as the summative assessment in week 20 approached.

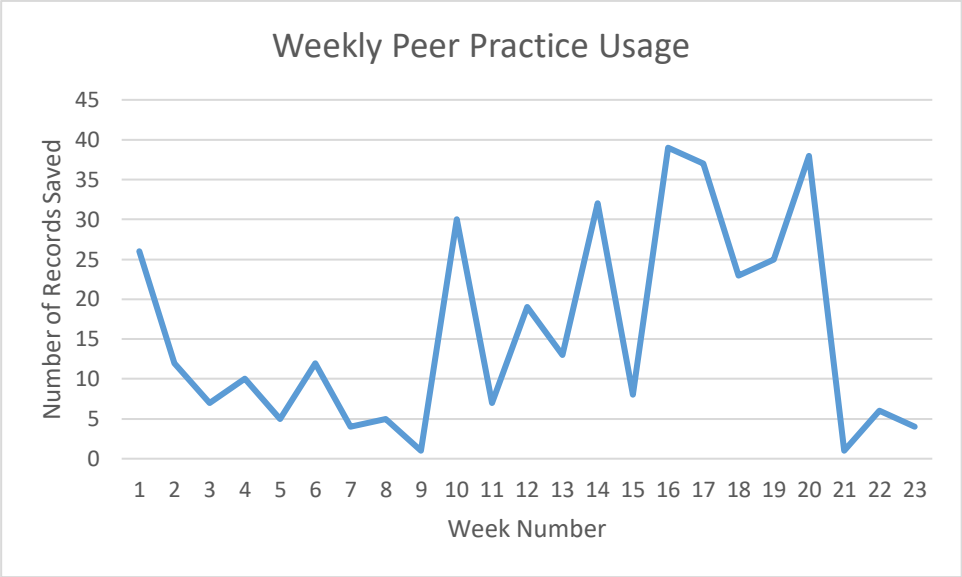


Figure 4-k Mobile Application - Frequency of Saved Peer Practice Record

4.9.3 Acceptability data – Peer Practice Evaluation

This survey was completed at the same time as the second Peer Learning Attitudes Survey so again had 156 respondents (response rate = 65%).

4.9.3.1 Overall views

In general, students had very positive responses to the introduction of Peer Practice (Figure 4-l). Again, in each graph 1 represents Strongly Disagree and 5 Strongly Agree. Around 95% agreed or strongly agreed that Peer Practice was enjoyable (Question 1), that it helped improve clinical abilities (Question 2), that it improved the effectiveness of peer learning (Question 4), and that it should be expanded to include other subjects (Question 8). Despite this, only 1/3 thought that Peer Practice should be mandatory (Question 9), with 1/3 disagreeing and the rest neutral. Students were fairly neutral about whether Peer Practice had promoted a sense of community (question 7).

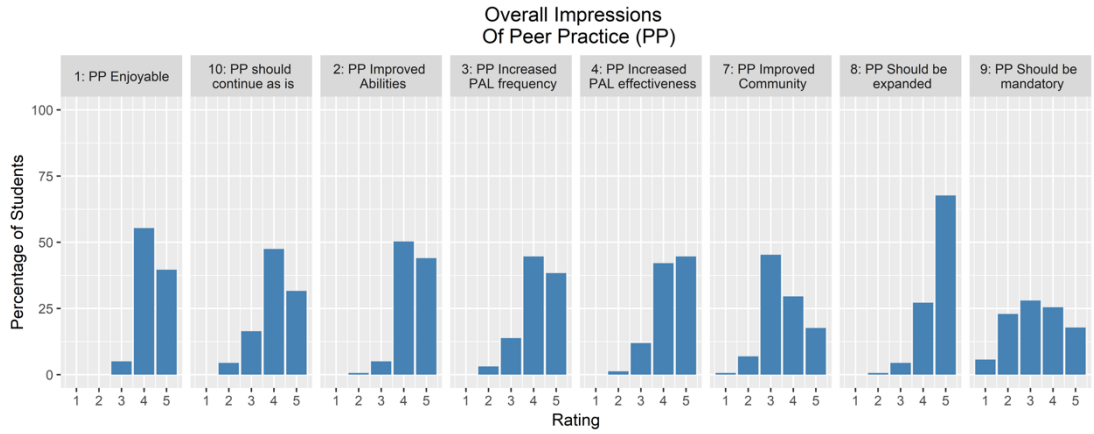


Figure 4-l - Overall Impressions of Peer Practice

4.9.3.2 Evaluation of the Common Criteria

As shown in Figure 4-m, most students found the Common Criteria easy to find and understand (Questions 11 and 12), with the vast majority considering that Common Criteria improved the quality of consultations (Question 13).

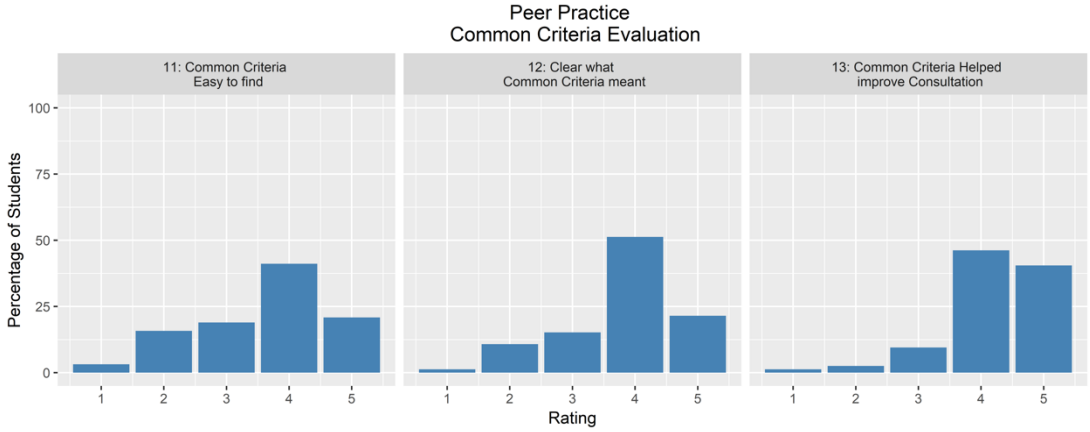


Figure 4-m - Common Criteria Evaluation

4.9.3.3 Technology and App Evaluation

Figure 4-n shows the questions related to the Pebble Pocket Mobile App. Most agreed that it was technically easy to download (Question 16) though the data on how easy and useful it was to save electronic records was more mixed (Question 19 and 20). Nevertheless, most students thought it made practising consultation with other students easier (Question 17) and agreed that it made seeing patients in clinical settings more likely (Question 18). I also asked students whether they preferred paper, pdf or the App versions of the Common Criteria. Around 50% preferred the app, 25% preferred paper or the pdf version, and the rest preferred some mixture of the two (see Appendix 8).

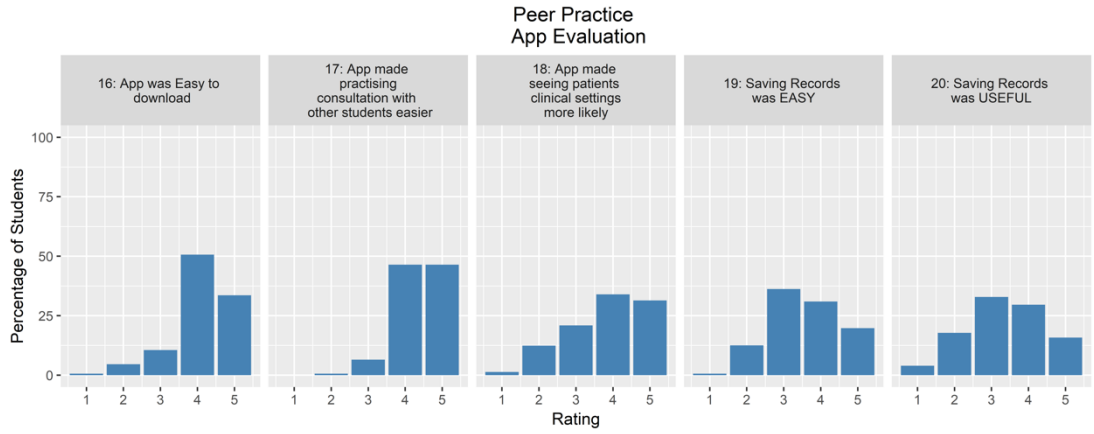


Figure 4-n Peer Practice Mobile App Evaluation

4.9.3.4 Peer Practice behaviours

To help gauge how the Peer Practice resources were being used, I asked students to estimate how often in the last 4 weeks they used either the App or the Common Criteria either alone or with their peers (Figure 4-o). From this it appears that the resources are used for both self-study and for peer learning (NA represents absent responses).

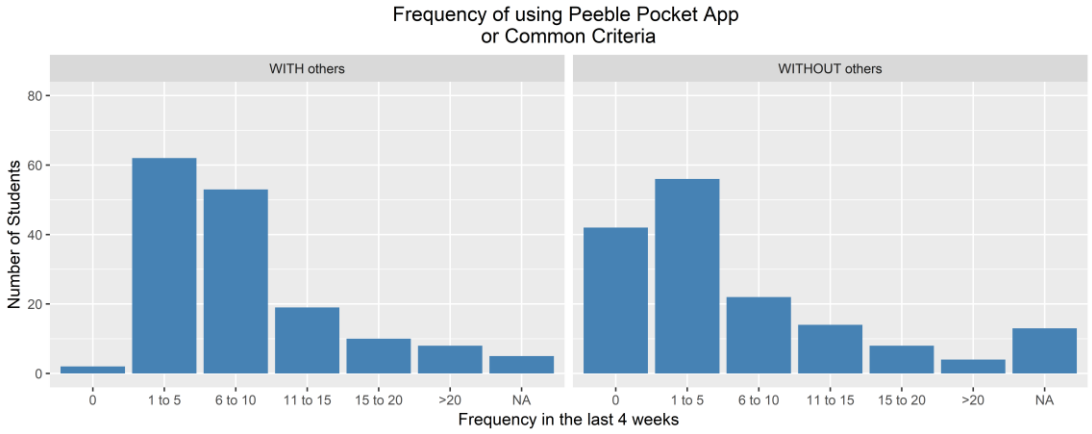


Figure 4-o Frequency of Use of Peer Practice Resources

4.9.3.5 Free Text Comments

There were 52 separate free text comments collected from the survey. 21 of these expressed praise for Peer Practice or asked for it to be expanded to cover other modules (such as neurology). 10 asked for improved record keeping, and a further 6 suggested technical changes for the app. 5 expressed concern about using phones in front of patients. The remainder either asked for timetabling changes to make it easier to do Peer Practice, discussed technical difficulties encountered with the app, or commented on the Common Criteria. 1 student noted that the main issue was finding enthusiastic colleagues to practise with, and 1 reiterated their resistance to making Peer Practice compulsory, noting that it would become a 'tick box exercise'. This respondent also stated that if record keeping became mandatory it would likely mean they would only record encounters when they were confident they would get a very high score in the encounter.

4.10 Discussion

This chapter has surveyed the literature on peer learning of clinical skills and identified a gap: while many studies have evaluated students' perspectives on peer learning of clinical skills in numerous contexts, and others have tested the performance benefits of clinical skills, none have tested the effect of reciprocal peer learning on performance in the clinical context.

In this practical trial, a crossover effect was used to test the effect of a reciprocal peer learning programme called Peer Practice on clinical competence, attitudes to peer learning and peer learning behaviours. The acceptability of the programme was also evaluated.

The research questions are provided again in Table 4-F with summary answers: these answers will be discussed in greater detail in the subsequent sections.

Table 4-F Summary of Results

1)	**Does reciprocal peer learning of consultation skills in the clinical context promote competence?**
	The effect on OSCE scores was small and the study was not expected to have the power to detect this result; It should be considered a borderline or null result.
2)	**a) How does experience of peer learning affect attitudes to peer learning in general?**
	Students' general receptiveness to peer learning improved after Peer Practice was introduced. Reservations about the value of providing peer feedback remained but were less strong after Peer Practice.
	b) How does experience of peer learning affect peer learning behaviours?
	Students were more likely to practise in pairs (in the absence of patients) after the introduction of Peer Practice
3)	**Is peer learning acceptable to students in clinical settings?**
	Peer Practice was generally well liked and acceptable with the Common Criteria being particularly valued. No complaints about the purpose of peer learning itself were voiced, though most students would prefer that it was not compulsory. The mobile application was helpful but many students prefer paper versions of the resources.

4.10.1 Question 1) Does reciprocal peer learning of consultation skills in the clinical context promote competence?

The OSCE performance data should be taken as a borderline or null result. Peer Practice students gained on average 0.3 marks in a 40 mark OSCE station where students had used Peer Practice. This is a statistically small effect size and does not provide a compelling reason to support peer learning. On its own it does not represent major gains in, for example, pass rates or patient outcomes, though we should note the spread of marks in the 40 mark OSCE is fairly narrow: a much larger increase in marks would have been surprising.

A small effect size *can* still have consequences. As noted in Section 4.9.1, the overall pass mark for the OSCE was equivalent to a Z-score of -2.50. Examining the Z-values for each student, three students failed their semester 1 subjects with Z scores of -2.70, -2.57 and -2.55 respectively. If Peer Practice increases performance by a Z-score of 0.14, then 2 of these students may have passed had they been using Peer Practice. There was 1 fail in the Semester 2 subjects, with a Z score of -2.68.

I do not mean to exaggerate the borderline impact of Peer Practice: but this shows how even small benefits can have meaningful impacts on outcomes such as pass rates or grade allocation.

Moreover, if the gain here *was* real and could be replicated in multiple domains, cumulative gains might start to become more important. If introduced early in the course, a small increase in many subjects over several years may start to influence overall competence and pass rates. . One critical point –this study *was* powered to detect moderate or larger benefits but did not find them. This is instructive: it cautions us to temper our expectations for peer learning. Committing huge resources to a teaching approach that does not show large early benefits would be unwise.

This equivocal result is similar to many of the other published series on peer learning of clinical skills. Several studies compared learning led by peers with learning led by faculty: Perry (2010), Knobe (2010) and Tolsgaard (2015) all found peer learning to be comparable to traditional teaching. In most of these studies the peer learning arm included specially trained students delivering teaching to their peers as student-faculty, and we would not expect students to be better than experts at teaching.

However Peer Practice was not intended to replace senior-led teaching and in fact was specifically implemented to complement it. The intention of Peer Practice was that the reciprocal element would improve students' abilities by augmenting and expanding existing peer learning within the curriculum. Other studies have shown clear benefits to peer learning versus individual learning: for example Tolsgaard *et al* (2013) found large effect sizes in the same consultation skills tested in Peer Practice. Why did Peer Practice not yield similar results?

There are several possible answers but one of the most plausible candidates relates to the difficulty of measuring effects in the real world as opposed to laboratory or classroom settings: I have already discussed the multiple confounders that plague real world randomised control trials. A particular challenge for the Peer Practice study design was the problem of 'leak'. All students had access to the Peer Practice app for *all* subjects from the start of Semester 2 i.e. a student undertaking Cardiology and Respiratory medicine in Semester 2 would still have access to the app checklists for Orthopaedics and Gastroenterology (which they had studied in Semester 1). This may 'dilute' the effect of Peer Practice on OSCE scores since students could practise consultation skills using the app (or with transferrable skills gained in Peer Practice) in their Semester 1 subjects prior to the OSCE. While the importance of using Peer Practice during the Semester 2 teaching weeks – with all the timetabling incentives etc. – will still be tested, the impact on OSCE scores is likely to be attenuated. I was not able to test for these

effects, though future work could examine student behaviours with this in mind.

It was not possible to prevent this leak effect – students could always share their resources and revise with friends from other groups. Even if a technical solution to this was found, it would have to be weighed against the issue of fair distribution of resources discussed in the ethics section.

An alternative would be to have a pre- *and* post- OSCE. This has its own issues, described in section 4.10.1.1 below.

It may also be the case that the groups were not even – students may have benefitted more than was apparent in the crossover comparison if e.g. Semester 1 Cardiology students were significantly better at Cardiology at baseline than Semester 2 students. However given the random allocation of students this seems unlikely.

4.10.1.1 Strengths and limitations of the data on performance

Here I will consider various strengths and weaknesses of the data used to answer the question 'Does peer learning promote clinical competence?'

One strength of the Peer Practice OSCE data lies in the value of the OSCE as an assessment tool. In OSCEs one or more examiners gauge student performance against predefined criteria or marking schemes. Like any assessment it has limitations. Many of the studies in the literature review that measured performance used bespoke measures such as single-station OSCEs or similar. Such 'tests' may be limited by poor standardisation and give rise to unsupported conclusions (Schuwirth and Van der Vleuten 2013). The OSCE used in this thesis was standardised, included multiple raters, with a moderate high reliability (alpha 0.64) consistent with the performance of OSCEs reported elsewhere (Brannick *et al.* 2011). Measurements are therefore fairly likely to reflect genuine clinical ability. Even so this reliability is not 100%, and the OSCE remains an imperfect measure of competence.

Another strength was its statistical approach. The pre-planned power analysis suggested I did have enough students to detect an improvement in clinical performance by one mark or two marks in the OSCE– a meaningful amount given the distribution of scores in each 40 mark station (data not shown). That I did not achieve this is unfortunate, but the attempt was reasonable and so practically (and ethically) justified. Running underpowered trials that are expensive or time consuming but have no reasonable hope of finding a genuine result is at best a waste of effort, at worst unethical. This study also made appropriate adjustments to avoid over-testing, such as the Bonferroni calculation employed in the comparison of peer-learning frequencies – failing to adjust *p*-value thresholds when multiple tests are done risks accusations of data-mining (Norman 2014a).

This part of the trial has several limitations. The confounding problem of 'leak' has already been addressed. The statistical effect size was not expected to be detected by our pre-planned power calculation. The real impact on performance would ideally require further study with a larger sample – approximately twice as large according to the post-hoc calculation. Nevertheless it seems unlikely to be far different in either direction, so I can have some confidence that peer learning does not lead students astray.

The problem of 'something is better than nothing'. One criticism of trials in education is that there is no 'placebo' in education and that giving more teaching always results in better performance (Cook and West 2013). Since any teaching works, demonstrating a benefit from one type of learning does not solve the problem of what to prioritise in one's curriculum. If Peer Practice was simply *more* teaching then any benefit is not necessarily due to peer learning and it does not strengthen the case for an expansion of peer learning in local teaching. However, this charge does not seem to apply here – the alternative to Peer Practice already involves informal peer learning and a great deal of other teaching. The difference with Peer Practice was its formalisation of the peer-peer interaction, the easy accessibility of resources designed to improve the quality of a peer learning encounter, and the

timetabling changes that make it easier to engage with this in *otherwise free* time. It is still possible that Peer Practice encourages students to spend more 'time on task,' but as a project that took no time away from other teaching, the practical downside of this is minimal.

This also has efficiency gains for time-pressed teachers: Peer Practice had educational benefit without allocating significant professional teacher time during the modules. This is considered a practical advantage of peer learning in general (Ten Cate and Durning 2007a).

Order effects. Students may do better in their Semester 2 subjects than their Semester 1 subjects simply because they have studied them more recently. I examined historical data using the same Semester 1 vs Semester two-sided Student *t-tests* and found no evidence of this phenomenon (data not shown).

Teaching to the test. If the Common Criteria reflect real OSCE mark schemes too closely, any improvement may be due to surface learning of assessment technique and 'regurgitation' of standards rather than genuine learning (Cook and West 2013). However, the nature of clinical skills would seem to circumvent this problem since repetition of well understood criteria and deliberate practice are considered key to competence (McGaghie *et al.* 2011). Further, OSCE mark schemes were developed independently based on module learning outcomes: they were not based on the Common Criteria directly. The latter were a guide to the components of competence, not a publication of assessment papers.

Knowing the standards vs the effect of peer learning. If assessment scores improve simply because students become aware of what the assessment standard is then it is not necessarily peer learning that caused the improvement. However, since all students could access the Common Criteria from the start of the year, any measured difference is more likely to be due to the Peer Practice elements outlined above. I also identified an increased frequency of practising with colleagues in the second semester which coincides with the improved performance (Figure 4-j).

No baseline data. Differences between groups in final summative assessment may reflect baseline differences in abilities, but because of the prohibitive expense of running 'extra' multi-day OSCEs, I do not have performance data from before Peer Practice. However this seems unlikely to be significant given the random allocation of students across groups, and the fact that each student acted as their own control – their generic ability is presumably fairly stable. There are also many issues with pre-test and post-test result, most critically that pre-tests give students a 'sneak preview' of the content of the post-test – they become part of the teaching and make it hard to tell whether post-tests result from this or the teaching intervention itself (Norman and Eva 2013). Furthermore, if the Semester 1 assessment was formative, would it be taken as seriously, and if it was summative would students feel aggrieved by not having the Peer Practice to help study for it? All of these factors were considered during study design, but they remain a plausible explanation for why more compelling outcome differences were not seen.

4.10.1.2 Conclusion to data for Question 1

In spite of these limitations, the OSCE data provides some support for the performance benefits of peer learning in the workplace. While it was disappointing that a larger effect was not found, the other benefits of the project have to be considered. I now turn to the data on attitudes to peer learning.

4.10.2 Question 2a) How does experience of peer learning affect attitudes to peer learning in general?

The survey data provided plausible evidence of an improvement in attitudes to peer learning with increasing exposure to it. The small but measurable shift in attitudes makes sense when we consider the many positive benefits others have reported with peer learning in the literature review (Duvivier *et al.* 2012, Tolsgaard *et al.* 2014, Tai, Canny, *et al.* 2016b): positive experience breeds positive expectations. I should note that this may not just be the effect of Peer Practice – students in this year had other exposure to peer

learning through another classroom based peer learning activity (their 'Student Selected Component 5b') as well as any informal peer teaching. As we saw in Chapter 3, it also seems probable that social bonds between students who get to know one another increasingly well build an atmosphere more receptive to peer learning.

Even so, this improvement in receptiveness to peer learning is encouraging: it suggests that intrinsic reservations for learning with peers can be overcome by positive experiences, and argues for an increased role for peer learning in medical school curricula. We know from the Grounded Theory chapter and from the literature review above that some students have concerns about peer learning, particularly the promotion of unhealthy competition (Tai *et al.* 2014) and the risks to one's self esteem or even mental health (Laidlaw 2009). If Peer Practice had exacerbated those concerns it would count against any other perceived benefits. On the contrary, improving attitudes would suggest that the drawbacks of peer learning are mitigated by increasing experience.

Because of concerns about data-dredging (Norman 2014a) the individual questions in the survey were not analysed statistically to test for change before and after Peer Practice. Still, a couple of responses are worth considering. In Question 22 I asked whether students agreed with the statement that 'I liked the use of peer feedback': around a quarter said they disagreed or strongly disagreed, but post-Peer Practice virtually no one disagreed (Figure 4-f and Figure 4-g). This is reassuring – having had experience of Peer Practice those students with reservations apparently changed their minds. It is notable, though, that in Question 25 the ratings for the statement 'I find it embarrassing to get feedback from my peers' the ratings did not change appreciably: this facet of reputational risk remains, even when overall receptiveness to peer learning increases.

How these attitudinal shifts relate to other skills such as team work is uncertain. It seems reasonable to assume that enthusiasm for peer learning would lead to enthusiasm for team working, and this has been found in other

fields: in a study in a Canadian business school, increasing exposure to peer feedback both improved receptiveness to feedback *and* correlated with increasing 'citizenship behaviours' and other team effectiveness measures (Donia *et al.* 2018). It makes sense that enthusiasm for peer learning would spill over into team work, but this is something that should be tested in the clinical arena.

4.10.2.1 Strengths and Limitations of the Peer Learning Attitudes Data

The high internal consistency of the questionnaire responses makes the comparison of average pre-and post-ratings worthwhile – the scale does seem to relate to an overall view on peer learning. While I have not explored exactly what the nature of that scale is, the content of the statements all appear to represent receptiveness to peer learning. This interpretation fits when we consider the roots of the scales in other surveys on team based and interprofessional learning (Parsell and Bligh 1999). This gives us confidence that the shift in mean scores in our Peer Learning Attitudes survey relate to a genuine increase in receptiveness to it.

There are some limitations to the interpretation of this data. It may be that the attitudes recorded in the survey are some kind of halo effect of enthusiasm for having the Common Criteria. However, these Criteria were available since the start of the year so this cannot explain the whole effect. A more significant problem is that the low response rate in the baseline data means I can be less confident that that sample is representative of the whole group's attitudes. It may be that I failed to sample those students at baseline who were most keen on peer learning, and their attitudes were included in the post-questionnaire. Or, the students most motivated to answer the first questionnaire were those who had the greatest reservations about peer learning. Examining the results, though, there seem to be very few who genuinely dislike the idea of peer learning. It would seem intuitively more likely that the most enthusiastic students answered the first questionnaire.

4.10.3 Question 2b) How does experience of peer learning affect peer learning behaviours?

There was some increase in time spent practising history and examination with peers in the absence of patients, arguing that the availability and incentives of the app makes peer learning more likely. However the lack of change in other types of peer learning – for example with patients present – suggests that this effect does not necessarily translate to the workplace. The hope was that Peer Practice would increase patient-contact time; I do not have direct evidence of this. On the other hand, in Question 18 of the Peer Practice evaluation, more than 60% of students did agree or strongly agree with the statement '[The Peer Practice App] made it more likely that I would practise [consultation skills] in a clinical setting'. The reasons for the discrepancy between this finding and the self-reported frequency data from the Peer Learning Attitudes survey are unclear, though both rely on self-report and memory; recall and other biases are likely to play a role.

More objective data from the Peer Practice App did suggest an increase in use of Peer Practice over time. This may reflect the motivating effect of the impending summative assessment, which would fit with data others report on reasons for peer learning of physical examination (Duvivier *et al.* 2012). This data is also flawed, though, as it is possible to use the app without saving a record, and many students did Peer Practice with paper versions of the Common Criteria.

Nevertheless, students did report that Peer Practice improved the quality of interaction when they saw patients on the ward with their peers (Peer Practice Evaluation Question 4, Question 13). This provides evidence that Peer Practice is still a teaching programme *for the clinical setting* and would suggest different behaviours within a consultation, though these have not been directly observed.

4.10.4 Question 3 – Is peer learning acceptable to students in clinical settings?

The survey on Peer Practice itself showed remarkably positive views of the enterprise. This is encouraging as it suggests that students are very receptive to the specific format of Peer Practice and have found it useful for their learning. Some of these are likely to represent the effect of the Common Criteria – an insight into the mind of the summative assessors? – but this is not the whole story. The ratings praised the way that Peer Practice augmented peer feedback and the free text comments emphasised the value of knowing what you had done and what you often missed. This fits with the widely reported benefits of peer learning (Secomb 2008, Tai, Molloy, *et al.* 2016, Herrmann-Werner *et al.* 2017). One interesting finding was that 25-50% of students preferred paper versions of the Common Criteria: this challenges the easy assumption that mobile technology is preferred by the current generation of students (Branigan *et al.* 2017). The reality is likely more complex as a recent AMEE guide suggests (Masters *et al.* 2016). Of note several students reported reservations about using phones in front of patients, a concern that some tutors share (Dimond *et al.* 2016, Masters *et al.* 2016). This in itself may suggest a reason for the lack of change in frequency of peer learning with patients – students who primarily preferred the mobile app might be reluctant to do peer learning in front of patients. The acceptability survey asked students about which contexts they use Peer Practice – its frequent use outside of the clinical environment suggests that any beneficial effect will at least in part be due to home or classroom use of the technology. This is unsurprising – the very flexibility of peer learning and the Peer Practice resources is part of their advantages over other forms of learning such as tutor-led lectures or tutorials.

The question about ‘compulsory use’ is important – even a well-liked activity can be seen as unwanted if it is obligatory. This paradoxical finding was also seen in the Grounded Theory chapter – known as ‘burdensome obligation’, a facet of *Authenticity*. It may relate to the superiority of intrinsic motivations compared to extrinsic motivation in self-determination theory (Ten Cate *et al.*

2011): the carrot and the stick may have competing effects. It may also relate to the risk of recording poor performance – one free text comment noted concern about 'recording my best performances' and several stated they preferred just having records on the app. Just 2 students submitted their formative records for central investigator review – even in formative learning the concern about appearing deficient remains.

4.10.4.1 Acceptability – Strengths and Limitations

The acceptability data again has limitations, particularly in the representativeness of the sample. While 65% of the year group responded to this survey this leaves around 1/3 of students whose views I can only infer. If these students were all particularly unhappy with Peer Practice then expansion of the project would risk imposing on them the tyranny of the majority. While we might expect those who actively disliked Peer Practice to have contributed to the survey, it does seem possible that the views of all students are likely to be a bit less positive on the whole. This should be borne in mind for the future – unexpected resistance could arise. This argues for the principles of practical trials that Tolsgaard (2017) outlines including long term follow up to identify such problems.

4.10.5 Practical Trials

Beyond the research findings themselves, this chapter has added to the experience of practical trials in medical education. As a relatively new concept in the field, there are a limited number of published studies. This study found an ethically acceptable way to include a whole year group in a prospective trial, and no students complained about the fairness of the crossover effect. While even this strategy was not able to include enough students to detect the effect size for our main outcomes, it represents an efficient way of enrolling large numbers of students into trials. A multi-centre study with similar strategy could reasonably expect to achieve the 350+ students in each group needed to detect most statistical effects in education (Hope and Dewar 2015).

The broad approach to consent taken here (and ratified by the ethics board) has been criticised in other studies (Tolsgaard *et al.* 2017). While written consent has been given by students in this study for their routinely collected educational data to be used in research (including summative assessment data), I did not ask students to sign written consent for their group allocations in the crossover. I judged our approach to be equitable as discussed in the ethics section, but it is not the same as the written informed consent found in, for example, randomised controlled trials. Still, there is clear legal and ethical support for this, such as the use of routinely collected student and trainee data shared as part of the UK Medical Education Database projects (Dowell *et al.* 2018), and national UK guidance that states it is routine practice not to seek individual consent in the similar field of cluster-randomised trials (Craig *et al.* 2008).

One of the perceived advantages to practical trials is their reflectiveness of real world practice (Campbell *et al.* 2000, Tolsgaard *et al.* 2017) but this study has highlighted some drawbacks including the various confounding factors outlined in the discussion section around Question 1. The issue for this study was that I may have had a real impact on student performance but

that this was masked by the 'leak' effect. There remains a tension between pragmatic design and drawing sound scientific conclusions.

Nevertheless the experience of practical trials has been positive – this study has attempted to overcome the challenges of demonstrating educational value of a new intervention with a multi-pronged research approach. If I had simply asked 'does peer learning improve performance' and received a null result it would have been very difficult to justify continuing Peer Practice. However, the extra benefits of a reasonable improvement in attitudes towards peer learning – an aim approved by regulators (General Medical Council 2015) – an increase in the frequency of peer learning, and its very positive reception by students all argue for Peer Practice's value. The programme continued in the subsequent academic year.

4.11 Future Directions

This research also tells us where to go next. Future research should seek to test whether there really is a small performance gain, perhaps by replicating a similar study with other academic centres to reach the critical sample size. Furthermore, designing ways to check for increasing benefits of peer learning over time – say 3 years – could test for the cumulative benefits I speculated on above. The Peer Learning Attitudes survey could also be used longitudinally, for example to test the stability of these attitudes over time or after transition to other locations and cultures. Exploring why Peer Practice is not used as much in the clinical context as intended would also be fruitful; some insights from the Grounded Theory Chapter 3 of this thesis will be drawn in the final chapter. The acceptability data are also fertile ground for refining and innovating Peer Practice for future use in this centre: the positive response has already led to expansion of the app and the Common Criteria into other clinical subjects. Finally, advocates of practical trials also suggest the use of cost-effectiveness analysis (Tolsgaard, Tabor, *et al.* 2015), asking if the outcome is worth the financial expenditure. With adequate statistical expertise, such an analysis could be performed for the current study, assuming its improvement in performance is genuine.

4.12 Conclusions

The Peer Practice study addressed a gap in the literature on the use of peer learning in the clinical context to teach consultation skills, a key type of clinical skill. It used innovative research design based on the principle of practical trials to test the role of Peer Practice, a reciprocal peer teaching programme for the clinical setting. It suggested a small benefit to performance (or at least no harm), found a positive effect on attitudes to peer learning, a positive effect on learning behaviours and was warmly received by the students involved. This multi-modal assessment has therefore demonstrated benefits to multiple stakeholders – teachers, regulators and students – and expanded knowledge in the field of peer learning.

The main caveats are of the borderline benefit to OSCE scores – though this itself is helpful in that it limits overenthusiastic investment in peer learning – a lack of compelling clinical benefit, and of a proven increase in the amount of time students spent with patients in the clinical arena. This is offset by an apparently improved quality of patient-student contact, and the other benefits listed above. The study has also provided extra experience and insight into the running of practical trials as a research approach.

4.13 Reflections

This chapter presented several important development opportunities for me as a researcher. The literature review – taking a more traditional approach than Chapter 3 – was valuable training in critical review of medical education research and clarified for me the importance of appropriate statistical approaches and reporting. It is sometimes surprising to see the confidence with which small studies with borderline results report great advantages and advise others to invest time and effort in adopting their methods. Even as an advocate of peer learning it seems to me that the empiric support for it is modest or absent in many cases. That was part of the reward in attempting a more rigorous approach here. Despite the equivocal result when it comes to the main finding, it has been extremely helpful for me to gain experience in instrument design, statistical interpretation of data, and practice at presenting such information in an academic report. The experience of ethical assessment and external review is transferable to other contexts where the same issues arise, and the sort of trial design I employed could be used in various educational and clinical contexts.

In Chapter 2 I looked at student priorities with discussion of how peer learning might fit into this; in Chapter 3 I explored the theoretical aspects of peer learning and developed a model to guide action; in this Chapter I tested the effect of peer learning in a real world trial. The final chapter will summarise the findings of the whole thesis, discuss its cross-chapter conclusions and suggest ideas for future work.

Chapter 5 Conclusions

5.1 Introduction

In this final chapter I will summarise the findings of the other chapters and discuss the overall conclusions that can be drawn by considering them together. One challenge in drawing conclusions from diverse research designs – including qualitative and quantitative data, thematic analysis, grounded theory, experimental methods – is that it can be difficult to synthesise these formally. In the field of mixed methods research the solution to this challenge has stimulated much debate (Creswell 2010) including the assertion that these are incommensurable in a formal sense (Guba and Lincoln 1994). However, a common approach for reviews in medical education is to take an inclusive approach with different methodologies (Haig and Dozier 2003). Numerous examples can be found in this thesis already e.g. (Burgess *et al.* 2014b, Rees *et al.* 2016, Tai, Molloy, *et al.* 2016, Herrmann-Werner *et al.* 2017). The approach here will therefore be narrative, drawing links and connections where I consider it relevant and fair to do so.

5.1.1 Recap of Conclusions from Chapter 2, 3 and 4.

Chapter 2's published paper used a constructivist framework and thematic analysis to explore the priorities of medical students. Its findings included concerns they had about the processes of medical school – how learning should happen, taking part in clinical care, the importance of being known as individuals – and outcomes – achieving competence, being the best, and personal development. The chapter reviewed these results again through the lens of peer learning and noted how peer learning could support many of these goals, for example by helping build community, boosting performance, improving understanding of assessment standards, and providing social support. However some of these goals may be difficult to reconcile with peer learning where goals might conflict with one another, or where time spent learning with peers is seen as distracting from engagement with clinicians.

Chapter 3 addressed some of these potential conflicts by using Classic Grounded Theory to develop a model of how students make decisions about

peer learning. In short, the model explains how students 'get ahead while getting along' with their peers. Depending on *Opportunities* to take part in peer learning and the alignment of factors that allow a *Threshold* to be crossed, students undertake *Internal Negotiation* to constantly balance and re-balance the educational and social pressures of *Expected Educational Gain*, *Social Reward* and *Social Risk.* This leads to various types of engagement or disengagement with peer learning, and the theory suggests factors that educators could try to alter to get the best from peer learning initiatives. The comparison with other literature found that much of the existing theory in medical education treats peer learning as a generally positive thing, and while it notes potential drawbacks, does not have a formal theoretical explanation for them. Literature in other fields such as psychology supports the role for a multi-dimensional theory as in the theory of *Internal Negotiation* that accounts for both positive and negative influences.

Chapter 4 critiqued the literature on the peer learning of clinical skills and found that very few studies have looked at the way students teach one another these skills in the workplace. None have measured the effect of reciprocal peer learning on clinical performance. It then presented the Peer Practice project which used the framework of 'practical trials' to test its effects in education. Using a modified crossover effect I measured the impact of workplace-based peer learning of consultation skills on performance in an OSCE, attitudes to peer learning and learning behaviours, and appraised the acceptability of this to students. A possible (but borderline) benefit to clinical performance was suggested, though due to statistical power considerations this should ideally be repeated with a larger sample. I found moderately strong evidence of an improvement in willingness to use peer learning, frequency of practising consultation skills with peers, and found that Peer Practice was in general very widely accepted.

The following sections will examine these findings in the light of the other chapters.

5.2 Chapter 2 Revisited

Chapter 2's paper on the student priorities (Storrar *et al.* 2019) provides a useful reference to their over-arching aims and how they might fit with peer learning. For clarity, the major goals that students had are reproduced here, once more under the headings of Content and Process.

Table 5-A Table 1 – Student Priorities grouped by Theme

Students were asked what mattered most at medical school and answers were grouped according to emergent themes. Some priorities had a greater emphasis on elements of content, and others on elements of process.	
Focus on Content	**Focus on Process**
Being the best - Exams and Ranking - *Curriculum vitae*	**Being known and personal identity** - Recognition of achievement - Personalised teaching and feedback - Being welcome - Reputation and prestige
Preparation for Practice - Competence - Avoiding Error	**Feeling Useful** - Part of the team - Learn by praxis - Looking after patients - Satisfying clinical experience
Personal Development - Non-technical skills - Develop Wisdom - Develop Autonomy - A sense of wonder	**Good Relations** - Peers and family - Staff and faculty - Patients **Fairness and comparisons with peers** **Being part of something big** **Happiness and Stress Control**

5.2.1 Chapter 2 in relation to the grounded theory of *Internal Negotiation*

In Chapter 2, I related students' priorities to peer learning generally. This process can now be repeated through the lens of the grounded theory of *Internal Negotiation* produced in Chapter 3. I start with the priorities grouped under the theme of Content, which included notions of 'being the best', 'preparation for practice' and 'personal development' including building wisdom, autonomy and a sense of wonder (Table 5-A). These appear to fit nicely under the heading *Expected Educational Gain*, which was defined as 'The judgement of how likely the encounter is to help the student achieve educational aims'. A given student's willingness to participate in peer learning is influenced by how it fits into his or her overall educational goals. If a student believes that the peer learning opportunity will help in 'being the best' through excellence in summative assessment or developing CV-building opportunities they are more likely to engage. If the peer learning is seen to promote technical competence in e.g. consultation skills then again this aligns with the overall goal of 'preparation for practice'. The 'personal development' goals are perhaps less tangible, but favourable experience of peer learning and learning without formal tuition could enhance a feeling of autonomy, self-regulated learning (Rashid *et al.* 2016) or sense of wonder: research supports these perceptions (Duvivier *et al.* 2012, Tai, Molloy, *et al.* 2016).

Conversely, peer learning may conflict with these goals. Most notably, the 'being the best' principle may lead students to disengage with peer learning for fear of helping a competitor. This was dealt with in the theory with the idea of negative *Expected Educational Gain* i.e. helping a competitor is antagonistic to the student's goals. Overcoming this particular contradiction may not be feasible through better design of peer learning, but the grounded theory at least helps us explain why peer learning might be popular for some students and not others; they have different priorities and preferences when it comes to *Expected Educational Gain*, *Social Reward* and *Social Risk.* Theories of peer learning which treat students as a homogenous group who

are ‘socially congruent’ (Lockspeiser *et al.* 2008) or ‘at the same level’ (Topping 1996) miss out on this nuance and variation between students . A different approach is to consider each student’s behaviour as depending on putative traits such as ‘competitiveness’ or similar. This ‘individual differences’ approach is used by others exploring cooperation in the wider literature (Van Lange 2008). The advantage of this type of analysis is that it helps explain why some students like peer learning and others do not, and cautions against treating students as a single group. It may not be possible to meet the goals of all students adequately.

There is another reason for caution when considering students’ priorities in relation to peer learning: if ‘being the best’ is a strong motivator for academic success, we should be careful about aiming to try and remove competition entirely. Literature on competition highlights how it can result in better performance (Dovidio *et al.* 2008): simplistic notions of ‘competition is bad’ and ‘cooperation is good’ should be treated with scepticism. Indeed some approaches to cooperative learning seek to take advantage of this competitiveness; team based learning pits teams against one another in classroom teaching (Parmelee *et al.* 2012). This method also seeks to make students cooperate within the team, in part by an ingenious testing strategy that makes it apparent that the *team’s performance* is better than *even the best student’s individual performance* (Parmelee *et al.* 2012). This is an excellent example of designing peer learning to promote *Expected Educational Gain.* Whether such strategies can be applied in the clinical setting is worthy of further investigation.

The Process theme in Chapter 2 included the importance of ‘being known and personal identity’, ‘good relations’, ‘fairness and comparison with peers’ and ‘being part of something big’ (Table 5-A). Again these can be reinterpreted through the grounded theory. ‘Good relations’ now aligns well with the positive elements of *Social Reward* – helping other students and building relations – and so peer learning is helpful *if it promotes good relations*. On the other hand, the notion of *Social Risk* cautions the way that

peer learning could harm relations through the fear of embarrassment, patronising behaviour and so on. This argues strongly for the careful deployment of peer learning such that experiences are positive and low-risk.

Indeed this is the crux of the main concern of students in the grounded theory: 'getting ahead while getting along.' If students are given poorly planned or high-stakes peer learning experiences then enthusiasm would be hampered because of its conflict with the high level goal of promoting good relations. In a similar vein, students expressed concern for 'fairness and comparison with peers'. Again I note that peer learning advocates emphasise the social benefits of peer learning (Ten Cate and Durning 2007a, Tai, Molloy, *et al.* 2016) but the work in this thesis presents reasons to be cautious.

Something that the current version of the theory does not fully resolve is the tension of how peer learning can distract from the importance of 'feeling useful' and 'part of the team' (Table 5-A). We could call this part of *Expected Educational Gain* – peer learning has low expected gain if it distracts from team inclusion. In this argument, peer learning is just another teaching method like 'lecturing' or 'simulation'; something which has strengths and limitations when it comes to teaching, and something to be deployed judiciously depending on the teacher's intentions. Indeed a purely peer-led curriculum would have significant drawbacks, as those who have sought to substitute it for tutor-led work in assessment of training have found (Liu and Carless 2006). It may be that peer learning is better suited to some goals – such as preparation for practice' – than others – such as 'inclusion in teams'.

5.2.2 Chapter 2 in relation to Chapter 4 – Peer Practice

But perhaps this is not the point; peer learning in the clinical setting does not have to be an either/or enterprise and does not prevent students from enjoying other aspects of learning. Students in the Peer Practice project did not raise objections about being denied senior-led teaching. It appears that

Peer Practice did result in an overall improved attitude towards peer learning; if it had conflicted with their overall goals we would not expect to see this.

One reason for this may be the way that Peer Practice was deliberately targeted at the goal of 'preparation for practice'; consultation skills are part of a doctor's identity (Martens *et al.* 2009) and are clearly part of the competency goals in most outcomes frameworks (Federation of State Medical Boards of the United States and the National Board of Medical Examiners 2014, Frank *et al.* 2015, General Medical Council 2015). Moreover, the priorities paper in Chapter 2 included discussion of the importance of understanding what constitutes competence, and Peer Practice was constructed to help students understand the features of clinical history taking and examination that mattered to their teachers (and assessors). The alignment with the Common Criteria was a deliberate effort to make it clear to students what their tutors expected, something that advocates of peer assessment – where students judge one another's performance as part of learning - have recommended (Falchikov and Goldfinch 2000, Orsmond *et al.* 2000). The Peer Practice acceptability data found that students liked having clear frameworks with which to practise. The ready availability of 'approved' criteria also chimes with the emphasis on receiving personalised feedback that students want (Table 5-A): one purported benefit of feedback from peers is its easy and direct availability (Topping 2009).

Chapter 2 then has shed light on how peer learning fits with other educational priorities, which can in turn be explained by elements of the grounded theory of *Internal Negotiation* presented in Chapter 3, most notably *Expected Educational Gain*. It also explains some of the popularity of Peer Practice detailed in Chapter 4, particularly the benefit of having clear standards available to students.

5.3 Chapter 3 Revisited

The connections between Chapter 3's *Theory of Internal Negotiation* and the results of Chapter 2 have been discussed above. The connections with Chapter 4 are taken up here. What does the experience of Peer Practice tell us about the provisional Grounded Theory?

The grounded theory starts with the importance of *Opportunities* and *Thresholds*– chances to take part in peer learning and whether these chances are taken. The Peer Practice project was designed to present students with as many opportunities for peer learning as possible through structured timetable changes and other incentives. The mobile app was to be a stimulus for these opportunities, reminding students that peer learning of consultation skills could be done at any time in clinical placements. That Peer Practice was used so many times confirms that the *Threshold* was often crossed. The theory predicts that this happened because students felt there was sufficient *Expected Educational Gain* and *Social Reward* without undue *Social Risk*. Regarding *Expected Educational Gain* the experience of Peer Practice was clearly seen as valuable – its alignment with the summative assessment and the generally positive review speak to its perceived value. The increased frequency of use as the summative assessment approached (see Chapter 4, Section 4.9.2.1) also strengthens the notion of students deciding to take part in peer learning when it is seen to benefit their academic progression. If Peer Practice was seen as helpful, this may be because its elements were considered *Efficient* (i.e. easy to use and an effective use of time) and the authority of the Common Criteria lent the experience *Credibility* – students could trust one another's feedback because it was based on 'official' checklists and resources. Interestingly, the reluctance of most students to make Peer Practice compulsory fits with the notion of *Authenticity* where an otherwise helpful activity is somehow tarnished by extra obligations to assessors / academic regulators. Students perhaps become cynical of educators' motives. This, along with the issue of increased *Social Risk* with making peer learning compulsory or high stakes argue that part of Peer Practice's success lies in its formative and voluntary nature.

The *Social Reward* element is supported by the improved attitudes to peer learning found in the surveys. This is further strengthened by the frequency with which students report using Peer Practice with friends and other students. The virtuous cycles of friendship and study described by the theory appear to be active here. Peer Practice did not directly support the notion of *Social Grouping* or the *Competition Context* however. We might guess that students felt competition was not prohibitively overt and that social grouping was open enough, but I do not have enough data from Peer Practice to test these effects.

The properties of *Social Risk* are better addressed. The peer learning attitudes survey asked questions about embarrassment and these were consistently reported, even after students had used peer practice for some time. The notion of embarrassment or risk to one's self seems remarkably resilient (Laidlaw 2009). Note also that *Social Risk* is the *perceived* chance of harm, not the experience of harm itself; this becomes important when students mentioned the concern that they might look unprofessional using phones in front of patients[3], a finding reported by others (Dimond *et al.* 2016). This might explain why the data on Peer use in the clinical setting was equivocal: students reported they would be more likely to do it, but the (retrospectively reported) frequency did not clearly increase after Peer Practice was introduced.

Still, the theory predicted that social risk would reduce as relations build and confidence with peer learning improves; after peer learning was introduced students reported they found it easier to give peer feedback (see the answers to question 24 in section 4.9.2 in Chapter 4).

A further caveat on these findings – the theory of *Internal Negotiation* posits that much of the balancing of these factors takes place 'in the heads' of

[3] This has come out strongly in further work done by Jane Elford, a medical student whose research project asked students about practical barriers to using Peer Practice in the clinical setting. Intriguingly, they could not cite any actual incidents of patients complaining about phone use on the wards

students which is not something a crossover trial is designed to test. It is probably safe to conclude that the success of Peer Practice could be explained by features of the grounded theory, and that Peer Practice lends some support to elements of the theory, but not that the theory has been formally tested by Chapter 4.

To summarise, the experience of Peer Practice supports the existing model of the theory of *Internal Negotiation.* There were no major conflicts between the findings of Peer Practice and the theory, accepting that Peer Practice was not primarily designed to test the theories' hypotheses. It does suggest there is benefit to exploring some of the theory's predictions more deeply – in particular why peer learning was not used in the clinical setting as much as intended. These recommendations for future work will be discussed below.

5.4 Chapter 4 Revisited – Improving Peer Learning in the Clinical Setting

In this section I will focus on how the lessons of this thesis could improve peer learning in the clinical setting. I use the example of Peer Practice.

Peer Practice was coincident with improved attitudes to peer learning, and proved popular with students. However, there were equivocal results on the impact on performance, the frequency with which students used Peer Practice with real patients in the clinical setting. This is potentially disappointing given the projects' aims, but not surprising given the various factors in the theory of *Internal Negotiation* that limit engagement with peer learning and the complex influence of the clinical environment on collaboration (Duvivier *et al.* 2014, Tolsgaard *et al.* 2016).

One avenue might to be to take on the apparent conflict between students' desire for inclusion and the way that peer learning seems to distract from time with tutors (see Chapter 2's post-paper discussion). For example, students attached to hospital admissions wards could use Peer Practice to collaborate on admitting a patient then present to their tutors. If taking part in a ward round they could be tasked with seeing a patient and examining the respiratory system to report to the consultant in charge. They would thus be learning both from one another and from a senior tutor. This requires some investment from the medical faculty.

The grounded theory suggests other ways to improve Peer Practice. For example, greater efforts could be made to increase the *Opportunities* for peer practice through better integration with existing timetables and strong promotion by course organisers[4]. We could also strengthen the *Expected Educational Gain* of students by advertising the apparent performance gain afforded by Peer Practice, perhaps in terms of its effect on summative assessment scores. *Social Reward* could be improved by earlier introduction

[4] This is already happening – the respiratory module have reported increased adoption of the Common Criteria in their formative in-course assessment (minutes of year 4 meeting Sept 2018)

of Peer Practice in the academic year, giving longer for supportive relations to build and friendship-study circles to form. Similarly, we might expect *Social Risk* to reduce as students know one another better and can afford to take more risks with more established peer groups. This was the finding of Chou's group on peer feedback (Chou *et al.* 2013). The perceived risk of using phones in front of patients might also be reduced by explicit encouragement from senior clinicians, or advertising on wards to alert patients to this (approved) activity. If students are concerned about competition with one another – as *Social Reward*'s concept of *Competition Context* would suggest – then a de-emphasis on grades and ranking would seem appropriate. This is not, at present, possible in the UK system, where the independent foundation application system allocates points based on students' rank within their own class (General Medical Council 2017). Others have removed such systematic competition with positive results for peer assessment (Lurie *et al.* 2007).

Even so, this could be countered by a more open *Social Grouping* encouraged, for example by use of social activities to help students mix and get to know one another, or other efforts to build a collective identity as 'medics' all together rather than individualists (Chen *et al.* 1998). That senior students interviewed in the grounded theory seemed more open to working together than junior students also supports the longitudinal expansion of Peer Practice across the medical curriculum. This would be expected to be both educationally beneficial – as positive effects of practising with other budding experts accumulate – but also self-reinforcing as increasing experience of peer learning improves attitudes towards peer learning itself. This is supported by the findings in the peer learning attitudes survey (Chapter 4, Figure 4-h).

To recap, Peer Practice was popular and effective. It could be made better by learning the lessons of attending to student priorities, making opportunities frequently and easily available, accounting for the rewards and risks of peer learning and integrating it with clinical teaching over a prolonged period.

5.5 Summary and Synthesis

Having discussed how the chapters relate to one another, I will summarise the conclusions that the thesis presents as a whole.

This thesis started with contradictions in the way peer learning is presented; it is at once promoted as a popular and supportive way to train educator-physicians, yet is associated with unhelpful phenomena such as stress and adverse competition. Existing peer learning literature has sometimes sought to minimise the prominence of these contradictions – as in the conclusions of some reviews (Herrmann-Werner *et al.* 2017) – or presented students as a generic group of students with a general willingness to work together (Ten Cate and Durning 2007b, Lockspeiser *et al.* 2008). This thesis does not seek to ignore the benefits of peer learning, but we can improve it if we address the challenges directly. The theory of *Internal Negotiation* presents ways to understand and address the issues by seeking to encourage student engagement without causing undue harm. Appendix 3 presents a brief guide that educators may wish to consult with this in mind. We must remember, though, that the theory is not formally tested, and so these recommendations are plausible but not ironclad.

We must also not overreach. The problem of cooperation versus competition is an ancient one, as evolutionary theory attests (Hanley *et al.* 2008). The problem of 'getting ahead while getting along' may in fact be universal across human interactions and it is not within the powers of educators to solve such deep rooted problems. This limitation has real world examples – in a discussion on the use of peer physical examination, authors couched the problem in terms of overcoming student reservations to examine one another (Rees *et al.* 2005). This is well-intentioned, but we must question the limits of collaboration, particularly where cultural, religious or personal wellbeing is at stake; the mental ill health associated with social anxiety is an instructive example (Laidlaw 2009). It is incumbent on educators to realise that while they can reduce risks associated with peer learning, it is in the nature of risk

to result in harm more or less frequently. At the very least we should remain mindful of that as we promote peer learning.

We should also be careful not to assume that all competition is bad, and all cooperation is good. 'Being the best' is clearly a strong motivator for many students (Chapter 2) and perhaps this is something that peer learning should take advantage of rather than trying to minimise – groups can compete for desirable outcomes (Dovidio *et al.* 2008). The real world effects of any collaborative activity must be considered.

It is with this in mind that the second major strand of the thesis should be interpreted. The literature review in Chapter 4 demonstrated a gap in the evidence on the performance impact of peer learning in the clinical setting. Peer Practice was an ambitious project aimed at filling that gap. It demonstrated a small but plausible benefit to performance with other benefits for students' receptiveness to peer learning more generally. As a teaching practice informed by our grounded theory it advertises the benefits of attending to the contradictions in peer learning and the practical impact of *Internal Negotiation's* suggestions. Most notably the informal nature of the practice attempts to overcome *Social Risk* and the improved receptiveness to peer learning suggests this was effective. While the statistical considerations limit the confidence with which I can recommend Peer Practice's expansion based on performance gain alone, educators may well be interested in receptiveness to peer learning as a goal in itself.

Peer Practice has also contributed to the wider literature by its use of rigorous methodology – an ethically justified, statistically powered and broadly inclusive research design that could feasibly address the questions it set. This answers the calls for better designed research in medical education (Cook 2012, Norman 2014b) . The study was not perfect, but then real world research has to contend with real world limitations of resource, complexity and unpredictability (Craig *et al.* 2008, Tolsgaard *et al.* 2017). Such complexity is not *carte blanche* for imprecision, but the work has been presented with its limitations accounted for – readers can judge its merits.

We can also speculate on what this thesis means for preparation for practice. I have not demonstrated clinical outcomes here, but history and physical examination remain essential to clinical medicine and it seems likely that undergraduate performance translates into postgraduate competence; our method of testing competence using an OSCE remains part of the way that regulators assess clinicians both internationally and in the UK (Federation of State Medical Boards of the United States and the National Board of Medical Examiners 2018, General Medical Council 2018). Similarly plausible is the connection between abilities in peer learning and abilities in team working (Donia *et al.* 2018). If we see the skills inherent in peer learning as overlapping with those of team work (Salas *et al.* 2008) then Peer Practice might have a positive impact here too. This is important, particularly with notions of patient safety depending on effective team work (Weaver *et al.* 2010) and an ability to develop trust and honest critique in clinical teams (Appelbaum *et al.* 2016).

5.6 Key Priorities for Future work

While the discussion above (and in each of the preceding chapters) presents suggestions for further research, the following are considered major priorities

5.6.1.1 Test the grounded theory.

This could happen through individual assessment of the factors (e.g. quantifying *Social Risk* with a psychometric instrument), or more practically by designing teaching that seeks to take advantage of the theory and thus lending real world empiric support. For example, one could imagine testing the effects of *Social Reward* with open or closed competition contexts and the proxy measure of the peer learning attitudes survey.

5.6.1.2 Further testing of Peer Practice

Improving Peer Practice with the lessons learned above should make its gains more readily assessable. A larger sample could reasonably hope to test for the effect size detected here, and it further testing is warranted to justify the benefits detected in Chapter 4 (Cook 2014). Alternatively, a design that tests its rollout over a longer period could detect cumulative gains, particularly if the hypothesised positive and longitudinal effects on *Expected Educational Gain, Social Risk* and *Social Reward* are real. Ideally this would take place over multiple sites, and could utilise designs such as cluster randomised control trials (Craig *et al.* 2008) to achieve this. Moreover, if the effects are real, then cost-effectiveness studies are warranted to provide educational planners with further information on whether peer learning is worth it.

5.7 Final Conclusions

In summary, I have found that peer learning is likely to help with many of students' general priorities, can work well given the right balance of educational and social pressures, seems likely to encourage future peer learning and is widely accepted. Its impact on clinical performance remains uncertain.

Peer learning is generally a positive thing – we can make it better if we learn the lessons of its pitfalls and drawbacks, and how to enhance it using the lessons of the grounded theory of *Internal Negotiation*. It is possible to implement peer learning in the clinical context, and measure its benefits with careful study design.

This thesis has added to our understanding of peer learning in the clinical setting by establishing a practical and broad theoretical understanding of how students make decisions about peer learning, and providing high quality evidence about its impact in the clinical setting. It argues for the continued expansion and study of this important pedagogical method with a careful concern for the social and practical limitations of peer learning in medicine.

5.8 Final Reflections

The academic work published in this thesis has covered a lot of ground. While each individual component has been to some extent self-contained, one of the pleasures in writing it has been the development of links across different research methods and findings. I have found it refreshing to expose myself to elements of social theory, statistics, psychology, and of course the literature on peer learning. The flexibility afforded by pragmatism has been invaluable here, as has the open minded support of my supervisors who allowed me to explore all of these avenues. I have enjoyed developing skills in grounded theory, research grant bids, ethical applications, trial design and statistical analysis, as well as in academic writing, presentation and publication. I trust that the substantive findings are helpful to others interested in peer learning – my own enthusiasm for it remains strong.

Appendices

The appendices are listed here. For some cited documents, minor formatting errors have been introduced to improve readability.

Appendix 1 - Ethics Application for Chapters 2 and 3

This is the ethics application submitted and approved for the interviews used in Chapter 2 and 3. The original application had its own appendices – these are relabelled as sub-appendices here.

This appendix includes

- The ethics application form
- (sub) Appendix 1 – The consent form
- (sub) Appendix 2 – Adverts for students
- (sub) Appendix 3 – A copy of the interview schedule
- The ethics approval communication

MVM Education Research (EREC) Project Application Form

Project Title

Exploring and addressing the culture of learning and cooperation as part of preparation for practice

1. Study personnel

Name	Email	Phone No	Position
Dr Neill Storrar	Neill.storrar@Ed.ac.uk	242 9402	Clinical Fellow
Professor Helen Cameron	Helen.cameron@ed.ac.uk	242 6651	Director of the Centre for Medical Education
Dr David Hope	David.Hope@ed.ac.uk	242 6651	Fellow in Medical Education (Psychometrics)
Catherine Talbot	Catherine.talbot@ed.ac.uk	242 6651	CME Senior Administrator

State which staff member is taking overall responsibility for the conduct of this research and is the guarantor of the accuracy of this application. Please provide the title, position, and contact details for this individual. This individual would normally be a member of academic staff.

Dr Neill Storrar, Clinical Fellow in Medical Education, Centre for Medical Education, University of Edinburgh 49 Little France Crescent, Edinburgh EH16 4SB

2. Aims

State briefly the main reason for carrying out this research. Is a specific hypothesis being tested? What do you wish to find out? [most boxes will expand with text]

Aim

This research project is aimed at understanding the connections between the way that medical students cooperate and the way they learn clinical consultation skills. By first exploring the culture of student learning – the extent to which students feel motivated and supported in their learning, how they approach education, the atmosphere in the medical school – it will then develop a model of the influences on cooperation in students' learning

3. Summary of research (300 words) [most boxes will expand with text]

Research Questions

Exploring the learning culture amongst medical students

1) What is the learning culture amongst medical students?
   a. What do students see as their main motivations to learn?
2) How do students perceive the role of their peers in learning?
3) What is the role of cooperation amongst medical students in the learning of clinical skills?

Design

This study seeks to develop an understanding of the learning culture and the nature of cooperation in relation to learning consultation skills – in particular the factors that influence how and when it happens. The approach used will therefore be grounded theory (Glaser and Strauss 1967). In this methodology, researchers seek to gather data and generate theory from it, rather than take existing theory and test its implications.

The initial sampling would be of medical students who are engaged in learning these consultation skills, and staff members with involvement in training these students. These are students in their fourth year of the local curriculum. The students would be interviewed individually in order to gather a range of experiences and views, and to ensure confidentiality should any negative of sensitive issues be shared.

Staff groups would be interviewed in focus groups because the aim here will be to build consensus about learning culture and the role cooperation should play in student teaching.

4. Funding source (if applicable)

This work will be undertaken as part of an MD project, and so researcher time will be supported by those funds.

5. Start and end dates

When are students being recruited, and when are they being asked to take part in any interviews or experiments? [see notes relating to exams in the guidance]

Start Date	Completion Date
January 2017	December 2018

6. Relevant literature review and references [boxes will expand with text]

We know that students learn clinical skills together both as part of scheduled teaching and in their own time (Duvivier *et al.* 2012) and that cooperation with peers can boost performance (Tolsgaard *et al.* 2016) but we do not have a full understanding of the influences of this, particularly in the clinical environment. Such instances of peer assisted learning (PAL) are part of a wider educational context, and while PAL may have potential benefits in terms of promoting collegiality and a positive learning environment (Ten Cate and Durning 2007a) the evidence for this is largely based on surveys of student satisfaction (Tai, Molloy, *et al.* 2016).

In order to better understand the interactions between learning culture and student cooperation, we need a closer understanding of that culture – what do students see as being the important aspects of learning, what are the 'shared beliefs, practices and values that underpin' learning (Watling *et al.* 2013b, Watling 2015)? Studies that have looked at this have identified the potential for an unhealthy atmosphere of competition between students (Lempp and Seale 2004) and this is clearly something we would need to understand in our own context to help plan innovations that might address such issues. Some studies have sought to measure the effectiveness of the learning culture through items such as the Dundee Ready Education Environment Measure (Roff *et al.* 1997), and there is work on measuring individuals and groups according to where they lie on a scale of Individualism-Collectivism (Chen *et al.* 1998). Both of these are tools for measuring rather than understanding the culture. The items in these studies can help direct our inquiries but we are interested in developing a new theory about the way students learn together and how this can be best promoted within the clinical experiential context**.**

In summary, while there is data to suggest that students learning together can be beneficial, we do not have a complete picture of what influences this in the clinical environment. There is also a need to understand the way that the general learning culture influences students' approach to learning particularly in relation to cooperation and clinical skills. This study will seek to address some of these issues.

Chen, C.C., Chen, X.-P., Meindl, J.R., 1998. How Can Cooperation Be Fostered? The Cultural Effects of Individualism-Collectivism. Acad. Manage. Rev. 23, 285–304. doi:10.2307/259375

Duvivier, R.J., van Geel, K., van Dalen, J., Scherpbier, A.J.J.A., van der Vleuten, C.P.M., 2012. Learning physical examination skills outside timetabled training sessions: what happens and why? Adv. Health Sci. Educ. 17, 339–355. doi:10.1007/s10459-011-9312-5

Lempp, H., Seale, C., 2004. The hidden curriculum in undergraduate medical education: qualitative study of medical students' perceptions of teaching. BMJ 329, 770–773. doi:10.1136/bmj.329.7469.770

Roff, S., McAleer, S., Harden, R.M., Al-Qahtani, M., Ahmed, A.U., Deza, H., Groenen, G., Primparyon, P., 1997. Development and validation of the Dundee Ready Education Environment Measure (DREEM). Med. Teach. 19, 295–299. doi:10.3109/01421599709034208

Tai, J., Molloy, E., Haines, T., Canny, B., 2016. Same-level peer-assisted learning in medical clinical placements: a narrative systematic review. Med. Educ. 50, 469–484. doi:10.1111/medu.12898

Ten Cate, O., Durning, S., 2007. Peer teaching in medical education: twelve reasons to move from theory to practice. Med. Teach. 29, 591–599. doi:10.1080/01421590701606799

Tolsgaard, M.G., Kulasegaram, K.M., Ringsted, C.V., 2016. Collaborative learning of clinical skills in health professions education: the why, how, when and for whom. Med. Educ. 50, 69–78. doi:10.1111/medu.12814

Watling, C., 2015. When I say … learning culture. Med. Educ. 49, 556–557. doi:10.1111/medu.12657

Watling, C., Driessen, E., van der Vleuten, C.P.M., Vanstone, M., Lingard, L., 2013. Music lessons: revealing medicine's learning culture through a comparison with that of music. Med. Educ. 47, 842–850. doi:10.1111/medu.12235

7. Details of pilot studies and validation studies (e.g. questionnaires)

During the development of the MD proposal a number of staff members were interviewed on the subject of peer teaching, during which some elements of learning culture were discussed. These have informed the design of later materials and have been used to train the researcher on interview techniques.

8. Methods/research protocol (please review guidance notes carefully)

Please include copies of any questionnaires that are being used (as an attachment or appendix). If checklists are being used in interviews, please provide them. Include details of all demographic details you will record about subjects and any other information that might be considered highly personal. Expand this section as necessary.

The first part of the subject will use semi structured interviews – an example is attached in the appendix. Note that a key element of the research methodology – grounded theory – is that interviews will be adapted as data is analysed (Glaser and Strauss 1967) but the topics shown will be the basis of investigation.

Interviews will record student gender, age group, year of study and whether student is a postgraduate or an undergraduate medical student.

As stated above, we may later seek to survey students about aspects of learning culture and working with others, but this is not part of the initial project and it does not form part of this application.

9. External review

Who has provided external review of the proposed research? Please attach any reviewer comments.

Tim Fawns, Coordinator of the MSc in Clinical Education

Areas of substantive change suggestions - changes to proposal *in italics*:

6. [Conclusion to literature review]

"I think you need to tie your identified literature gap more closely with your aims. You are looking to understand culture, not to fix problems (at this stage)?" *-> comments on gap in understanding how to improve consultation skills removed.*

10. [description of student sampling approach to be clarified]

"Might just need to make it clear how many [in total]. So you could start with something like "We will interview up to 15 students in total" and then talk about how this is broken down into an initial sample and then more as needed" *-> sampling strategy clarified*

10. [Number of staff to be interviewed to be clarified]

"How many? This wasn't discussed above?"

-> proposed numbers clarified.

8. [Research protocol – previous statement that future interviews will be 'very similar to those shown' in the appendix

"I'd say that the topics shown in the appendix will form a basis for enquiry." *-> rephrased to make potential for future adjustment clear*

10. Proposed analysis

Provide details of how the analysis will be undertaken. Explain why you have chosen particular sample size(s). If you are intending to include all of a target group, justify why you have not chosen a random (or another method) of sampling.

Student sampling will be through invitation (see subsequent section) with the aim of conducting up to 15 interviews. The initial sampling will be 4 to 6 students in Year 4, the year where students focus most on honing / consolidating basic consultation skills in the clinical context. The principles of sampling in grounded theory are that sampling continues until no new themes arise ('saturation') – more interviews may well be required. We also note that subsequent sampling depends on the initial results (e.g. gaining views students of different experiences or seniority). We are therefore seeking permission to sample from other year groups if this proves useful to the developing theory.

Staff views will also be sought via focus groups, again to develop a rounded picture of the learning culture. We aim to hold 3 focus groups of about 6 staff members, with initial recruitment of staff involved in Year 4 educational roles.

The anonymised interview transcripts will be analysed with the aid of the computer programme NVIVO and data extracted for coding and theory building using the methods of grounded theory; the lead researcher NS will undertake this with recoding by HSC and/or DH to add rigour to the interpretation.

11. Recruitment

(a) Describe how subjects are to be recruited. Please provide copies of any advertising material, posters, emails etc. If slides are be used, please provide copies (attach as necessary).

An advertising slide will be included at the end of lectures, and notices placed on EEMeC and on posters in the medical school (see appendix). Students will not be directly emailed about the project unless they have already contacted the researcher expressing interest in participating.
Information leaflets will be available on EEMeC but also sent out to any participants.

(b) Do you think there is a possibility that a reasonable person might judge that students may feel pressured into taking part? Yes ☐ No ☒

(c) Is it clear that a student's decision whether to take part or not is private (that is that other students cannot work out whether another student has declined to volunteer).
Yes ☒ No ☐

If the answer to the above question is no, please justify what you propose.

(d) Can you confirm that recruitment is not taking place within a lecture or seminar (rather than at the end of a teaching session, via a slide or poster)

Yes ☒ No ☐

(e) Please provide a copy of the information sheet and consent form (if appropriate). If written consent is not being used, explain why you believe this approach is appropriate to your study.

See appendix

12. Data handling

Describe how you are complying with the relevant legislation. In particular:

(a) Which member of staff is the data guardian?

Dr Neill Storrar

(b) Describe *how* data is being kept including details of *how* data is de-identified or made anonymous.

Consent forms (which are not anonymous) will be held in secure locked facilities in the Chancellor's Building Interviews will be recorded digitally and transferred immediately to encrypted password protected storage in the university network accessible only by the researcher, supervisors and senior administrator. Files will be named by sequence number rather than student identifier, and a password protected look up list held in a separate digital folder. At transcription names of participants or referents will be removed and replaced with pseudonyms.

(c) How long is the data being kept for?

Per the university's research data management and retention policies, data will be kept for a minimum of 3 years or until the research, write up and publication is complete, whichever is longer.

(d) How can subjects withdraw consent (at all stages of the project)?

Written or email contact to the researcher, supervisor or external contact as outlined in the consent document. This will result in destruction of recorded data and transcripts and removal of content from any data analysis or write up that has occurred.

For **any identifiable data**:

(a) Are all machines password protected with robust passwords, or other security features? If using laptops are all the identifiable files encrypted. Yes ☒ No ☐

(b) How are paper records being kept and stored. What security measures and backup procedures are in place?

Paper records are kept in a locked cabinet in a locked office. Digital scans of these documents will be held in a password protected file with secure storage as a backup. The files on the university network are backed up regularly.

(c) Do you have a robust data backup strategy? Yes ☒ No ☐

13. Video or audio recordings

Does your research include the use of video or audio recordings? Yes ☒ No ☐

If yes, describe how the data is being kept secure, and access controlled. Are codes used for participants? How long will the raw data be kept for. How is the issue of withdrawal of consent in-group videos being dealt with? How are the files encrypted?

See description in Question 12 – audio files will be transferred to secure encrypted digital storage on the university network, with alias data in a separate look up list. Raw data will be kept in accordance with the data policy above.

14. Training of interviewers

If your project involves interviews, and sensitive issues are being covered, what training have the relevant staff had. How has their competence been assessed?

The researcher has undergone initial training with DH as part of his post at the CME, and undertaken several interviews with staff members already as a pilot. He has had further training in interviewing through a course in qualitative research method at the Welcome Trust Clinical Research Facility. Additionally, NS is experienced in handling complex, difficult and confidential information as part of his clinical work. Further interviews will be overseen by experienced senior researchers (DH or HSC).

15. Potential Distress or Harm

(a) What possibilities for causing distress or embarrassment do you think are present? What arrangements have you made to deal with these issues? If you are assuming use of support services or are directing students to support services, have you (or will you) inform these services? Have you discussed these issues with the Dean of Pastoral Affairs?

We are asking students about the culture of learning and their work with other students and are therefore covering normal day-to-day practice. We are not seeking data on unprofessional or illegal behaviour and it is extremely unlikely that participants will ask to talk about such subjects. At consenting for interview, it will be made clear to participants that any reports of identifiable unprofessional or illegal behaviour would lead to breach of confidentiality: normal professional guidelines for reporting such behaviour will be followed. The interviews may cover mildly sensitive subjects around peer support and the challenges of medical school, but we do not anticipate distress or embarrassment being an issue. Contact details for appropriate support services is included in the information leaflet that students will be given before and at the interviews. In the event of any significant negative institutional issues being raised, for example related to bullying, this will be escalated to the appropriate senior professional. In the first instance this would be Dr David Kluth, Head of Undergraduate Teaching. Dr Kluth is external to this research team. Dr Kluth will also be available as an external contact if participants want to approach someone external to the project with concerns.

(b) Studies that involve considerable time, or that they may cause students embarrassment or to reflect on academic failure should not take place close (2 weeks) of important exams. How are you dealing with this issue?

At invitation to interview we will ensure that students are not scheduled for important assessments in the following 2 weeks – this will be done by confirming with the students and consulting the curriculum/timetable on EEMeC.

16. Are you using deception as part of your experiment?

If the answer is yes, please explain and justify.

No

17. Probity and professional misconduct

Are you collecting data relating to activities that are either illegal or that may call into question a subject's fitness to practice; or information that might call into question the fitness to practice of others? Yes ☐ No ☒

If the answer is yes, we would expect a detailed justification, including details of how you intend to deal with these issues. Based on previous examples of such research we would likely need to take expert legal advice from the UoE. Review of such projects is likely to take longer than one month. We would expect that you have discussed whese issue with senior MVM staff prior to submission.

See above – this is not relevant to the topic of this study.

18. Potential conflicts between staff roles as researchers and examiners.

Can you confirm that those researchers who are aware of whether students choose to provide consent and take part in the study (or not), or who have access to identifiable research participant material, are not involved in any subjective student assessment (tutor reports, professionalism reports, CPE, vivas etc). Yes ☐ No ☒

If you are not able to comply with this, please outline a case for how you propose to deal with this issue.

The researchers will ensure that any students who are involved in the study will not be examined in the future in any of these subjective student assessments. Examinee lists will be screened to ensure the researcher does not assess these students. The relatively small number of participants will make this feasible.

19. Informing study subjects of results

Will and how subjects be informed of the results of the study? Who is taking responsibility for this?

Students will be asked at the interview whether they wish to be contacted when study results are available. At thesis completion and paper publication the lead researcher will email those who opt in with a link to the research findings.

20. Will you make your data available to other researchers?

Will the anonymous data be made available to other researchers in a form that is usable to them? What conditions will you attach?

The nature of interviews makes maintenance of confidentiality difficult if whole anonymised transcripts are made available: we will therefore not release this data. However, any quantitative data that is collected and the details of coding of qualitative data will be available on request.

21. Briefly describe any payments or other inducements you are offering students to take part in this study?

We will not offer a financial reward for participation, but will provide refreshments for participants.

(Sub) Appendix 1 - Information Leaflet and Consent Form for Interviews

Information Leaflet for Participation in Interviews and consent form

Thank you for considering taking part in this study.

What is the research for?

We are interested in understanding the environment in which students learn with one another. We want to understand what students find to be the most important aspects of their training, what motivates them to learn, who should contribute to their learning and how learning can best be supported by the medical school. The aim is to understand the way students approach learning so that we can improve it.

What would happen if I take part?

Participants will be interviewed individually and in private. This is to allow an in depth discussion whilst maintaining confidentiality. The interviews would take place at a time and place convenient to you that does not impact on your educational commitments. Interviews should take no more than 1 hour. Refreshments will be provided.

Your participation is entirely optional and your decision to take part will not be revealed to anyone.

Who is doing this research?

This is a study as part of my work as a Clinical Fellow in Medical Education at the Centre for Medical Education. It is being supervised by Professor Helen Cameron (Director of the CME) and Dr David Hope (Fellow in Medical Education - Psychometrics) and is organised by the CME.

Would the interview be confidential?

Yes, this interview would be treated as confidential. Confidentiality would only be breached in the event of serious concerns regarding identifiable professional misconduct or illegal activity. Any positive or negative aspects of learning environment could, however, be

discussed in general terms. This is in keeping with normal educational procedure. Transcripts will be made anonymous and not shared with anyone outside of the research group. Recordings and notes will be destroyed when they are no longer required for this project.

What should I do if I have concerns?

We do not expect any distress from participation in the study, but if there are any concerns you can speak to the researchers (details below), a staff member not involved in the project (David Kluth, david.kluth@ed.ac.uk), your personal tutor or the University Counselling Services (http://www.ed.ac.uk/student-counselling).

Will I be able to see the results?

If you would like to find out the results of the study you can contact the researchers at the contact details below, or request that we contact you once research is published.

Thank you very much indeed for considering this invitation; all input would be most welcome.

Best wishes

Neill Storrar
Clinical Fellow in Medical Education

Contact details

Dr Neill Storrar – neill.storrar@ed.ac.uk

Professor Cameron – helen.cameron@ed.ac.uk

Dr David Hope – david.hope@ed.ac.uk

Centre for Medical Education

Chancellor's Building

49 Little France Crescent,
Edinburgh, EH16 4SB

Telephone - 0131 242 6651

THE UNIVERSITY OF EDINBURGH

CENTRE FOR MEDICAL EDUCATION

INTERVIEW & FOCUS GROUP CONSENT FORM

Project Title: **Exploring and addressing the culture of learning and cooperation as part of preparation for practice**

Date and time:

_____

Researcher: _____

Participant name:

_____

& Contact details:

_____

_____

1. I agree to participate in an interview / focus group undertaken by The University of Edinburgh Centre for Medical Education and their research collaborators.

2. I have been given a full explanation of the nature, purpose and likely duration of the interview / focus group, and have been given the opportunity to ask questions about these.

3. I have been assured that my participation is entirely voluntary and I understand that I am free to withdraw my participation at any time without needing to justify my decision. I can also ask afterwards for specific comments not to be used in the research.

4. I do not in any way feel pressured into participating in this research, and will try to respond openly and honestly to questions.

5. I understand that notes will be taken and the interview / focus group will be audio-recorded and transcribed. These will be treated in strictest confidence and will only be accessible to the research team. Confidentiality would only be breached in the event of serious concerns regarding identifiable professional misconduct or illegal activity. Any positive or negative aspects of learning environment could, however, be discussed in general terms. This is in keeping with normal educational procedure. Data will be destroyed when no-longer required for the research

6. I understand that anonymous data from this interview / focus group may be published as research findings, including anonymised quotes, in journal articles, book chapters, on the world wide web or in a thesis / dissertation. I am aware that I can see any such material before publication upon request.

7. I understand that I can withdraw consent at any time by notifying Dr Neill Storrar (neill.storrar@ed.ac.uk).

Signed by the Participant:

_____

Date:

_____

(Sub) Appendix 2 - Adverts

Notice for EEMeC

What's it like being a student in Year 4?

We are interested in knowing more about how students approach their medical studies, particularly as they enter the clinical environment of wards and clinics. As you get more and more clinical experience, how do you learn? What's it like being in your year? What are your preferred learning methods? Do you learn best alone or with others? What are the things that motivate you?

We would therefore like to invite you to an interview to discuss these issues in more depth as part of research here at the medical school. The confidential interviews would take at most an hour, and should not interrupt your normal schedule.

More information is here: >link to information sheet appended to ethics application<

To volunteer to talk to us, please email

Neill.Storrar@ed.ac.uk

Or call 0131 242 9402

Poster for Medical school notice boards/slide at end of lecture

We want to listen…

- What's it like in Year 4?
  - What works best?
  - Who do you work with?
  - Is it what you expected?

Please get in touch to take part in this research

Neill.storrar@ed.ac.uk
Clinical Fellow in Medical Education
0131 242 9402

Scrubs.wikia.com

(sub) Appendix 3 – Interview Topics

Question Themes	Related Research Question
Learning Culture in medical school - How is it described? e.g. General atmosphere, Positive/negative features, apparent priorities at medical school, Interactions between students and teachers, degree of collegial atmosphere	1
Student approach to learning, perceptions of: - Overall aim of medical training, qualities of a junior doctor - Key motivators for learning - Who has responsibility for learning - The best ways to learn	1a
Interaction with peers - general relationship with peers - Who do students choose to learn with and why - explore role of collaboration, competition, cooperation	2
Learning consultation skills with others - Student perceptions of the value of this, when to do it, why or why not	3

(sub) Appendix 4 – Approval of Ethics Application

Subject	**Re: MVM Student Ethics Committee Application 2016/22**
From	MUIR Karen
To	STORRAR Neill
Cc	CAMERON Helen; HOPE David
Sent	12 January 2017 09:11

Dear Dr Storrar

Exploring and addressing the culture of learning and cooperation as part of preparation for practice.

Many thanks for submitting the amendments to your proposal, based on the committee's comments. I am pleased to confirm that your application has been approved by the MVM Student Ethics Committee.

Kind Regards

Karen

_____

Karen Muir, Secretary to
Professor Jonathan Rees FMedSci
Grant Chair of Dermatology,
Edinburgh Medical School: Clinical Sciences
University of Edinburgh

reestheskin
www.reestheskin.me — about me, and some other stuff
www.reestheskinblog.me — my blog mainly about medicine and education
open online resources
www.reestheskin.me/picgal/ — open image library of skin cancer
www.skincancer909.com — for an open access textbook of skin cancer
http://vimeo.com/reestheskin — some open videos (more on eemec)
http://eddermfaq.posthaven.com — ask a dermatology question (UoE students only)

Postal address:
Dermatology, Rm 4.018. Lauriston Building
Lauriston Place, EDINBURGH, EH3 9HA
tel: 00 (0)131 536 2041

Appendix 2 – Data Protection Policy

The Data Protection Policy produced to safeguard the thesis and research data

Data Management Plan Template for the University of Edinburgh

This template has six sections based on the University of Edinburgh Research Data Management Policy (http://www.ed.ac.uk/is/research-data-policy). For each question there is an example question (taken from existing shared plans) and basic University of Edinburgh guidance.

1. Data Capture

What data will be generated or reused in this research?

At each interview a paper consent form will be signed. Student demographics will be recorded on paper then transferred to an anonymised excel spread sheet, with a separate password protected look up sheet.

Interviews will be recorded with *.wav files.

Transcriptions via a secure service (https://www.dictate2us.com/services/transcription.php) will be saved as Word documents *.docx.

Anonymised data will be uploaded to the qualitative data management programme NVIVO which saves data as *.nvp.

A coding manual will be developed, with details saved as *.docx

How much data will be generated?

Less than 50GB of data expected. University storage allows up to 500GB

2. Data Management

How will the data be documented to ensure it can be understood?

Anonymised data will have a secure lookup sheet as above with aliases for each participant referenced against their Name and student/staff number. This will allow reference to the paper documents as well as electronic documents.

The NVIVO software will contain details of coding as will the coding manual.

Where will the data be stored and backed-up?

The data will be stored on the University of Edinburgh file store. “This is high quality, enterprise-class storage with guaranteed backup and resilience. The data is

automatically replicated to an off-site disaster facility and also backed up with a 60-day retention period, with 10 days of file history visible online". Source: University of Edinburgh guidance.

Paper documents will be stored in locked secure files in a locked office with only the research team and senior administrator having access.

3. Integrity

How will you quality assure your data?

Data quality will be ensured by comparison of the audio file with the transcribed information in repeat listening. Transcription itself will take place through professional transcription companies after ensuring any confidential information is removed by the researchers. Subsequent quality control will be through trained researchers accessing and analysing data, limiting access to study personnel only.

4. Confidentiality

How will you manage any ethical and IPR issues?

This project is being overseen by the University College of Medicine and Veterinary Medicine's Student Ethics Committee.

It is imperative that individuals who participate in this research have their identity protected – all participants will have pseudonyms, and any identifiable information deidentified before transcription. All participants will sign consent forms outlining the terms and limits of confidentiality including the need to break confidentiality if there is an ethical duty to do so.

The decision whether or not to participate in the study will also be confidential with all records of decision whether or not to proceed again to be kept securely.

Any research output will also be confidential with care to ensure that individuals or referents will not be identifiable.

5. Retention and Preservation

Which data do you plan to keep and for how long?

Consent forms will be stored for a minimum of 10 years, with all other data being kept for a minimum of 3 years from collection or until the project analysis, write up and publication is complete.

How will the data be preserved?

Information will be kept in the secured University network as above, with a reference document stating the nature of the contents. This may involved the Data Vault system identified below. Data will not be part of an open sharing scheme due to the confidential nature of interviews, but non-identifiable coding data may be available on request.

See note below about DataVault.

6. Sharing and Publication

Which data will be shared and how?

As above, the nature of the interview data means publication for data sharing is not deemed appropriate. At completion of the project, data will therefore be transferred to the University's Data Vault system once it is available:

http://www.ed.ac.uk/information-services/research-support/research-data-service/sharing-preserving-data/data-vault

Are any restrictions on data sharing required?

While the dataset deidentified, the nature of interview data makes maintaining confidentiality highly problematic. We will therefore not make interview data available to other researchers.

Update 30th July 2018

- Confirmed that all files deleted from secure dictate2us account neill.storrar@ed.ac.uk
- Permanently deleted all files from surveys on Bristol online surveys account neill.storrar@ed.ac.uk

Appendix 3 – Peer Feedback for Educators

This is a document produced as part of the Principal's Teaching Award Scheme funding. It is a one page guide for educators on the way the grounded theory developed in Chapter 3 can be used to guide educators planning peer feedback.

How to Engage Students in Peer Feedback

Neill Storrar, David Hope, Helen Cameron, Edinburgh Medical School: Medical Education. Contact nstorrar@ed.ac.uk

Students across many disciplines can provide great benefits to one another through effective peer feedback, but engaging students can be difficult. Our research suggests 3 major factors influencing students' willingness to participate. Educators should consider these when designing learning around peer feedback.

	Expected Educational Gain	Social Reward	Social Risk
Definition	Whether students expect material educational benefit	Students' desire to build social relations and help peers succeed	Risks of harm to reputation and social relationships
Effect on Peer feedback	Promotes participation	Promotes participation	Limits participation
An example	Students believe paired lab work will help prepare for practical assessments	Students in study groups know one another well and are not in direct competition	Students presenting papers are afraid of embarrassment in front of colleagues
Influence on learning design	Focus on learning that is *seen* to be beneficial e.g. directly helpful for summative assessments. Advertise the benefits heavily, and consider approaches that make peer feedback immediately rewarding. Let students participate in designing activities	Encourage repeated group contact to help build friendly relations. Consider making individual success dependent on group success. Use social activities to promote group bonds. Limit direct competition / peers awarding marks to other group members based on effort	Start with low-stakes / formative activities and encourage longitudinally stable groups to build trust. Provide training on how to avoid awkward critique e.g. ground rules for feedback conversations, objective marking schemes

A real example: Peer Practice

We implemented a programme called Peer Practice where students practise clinical skills in pairs in hospital settings. The Peer Practice mobile app aligns to summative assessment criteria (Expected Educational Gain). Groups know each other well and work together over a whole year (Social Reward). To reduce Social Risk the app provides 'safe' methods of critique through simple checklists and participation is routine / formative. Initial data found Peer Practice was highly valued by students, increased enthusiasm for peer learning and benefited performance.

Work supported by the Principal's Teaching Award Scheme Spring 2017. See full report at:
https://www.ed.ac.uk/institute-academic-development/learning-teaching/funding/funding/previous-projects/year/march-2017/peer-feedback

Appendix 4 – Evidence Base for Peer Practice

This document justifies the design decisions made during the development ot Peer Practice. It includes the various domains where decisions had to be made, summarises some key evidence and finishes with a recommendation for design

An Evidence Based Approach to Peer Practice of Clinical Skills

Decision	Evidence and Arguments	Recommendation
Summative or Formative	Students can make moderately reliable judgements vs faculty (Basehore et al., 2014; Li et al., 2016; Speyer et al., 2011) and we know factors that improve feedback reliability. Trained students can replace faculty (Bucknall et al., 2008) Students can identify those who do well over all (Lurie et al., 2007) Participation may improve if it counts (McGarr and Clifford, 2013). In longer term use students will do it summatively, though significant minority remain uncomfortable (Kovach et al., 2009) Students are reluctant to rate peer negatively (Hulsman et al., 2013; Rudy et al., 2001) Students would generally prefer it to be formative in the context of professionalism(Arnold et al., 2005). Feedback has greater impact when participants are novices (van de Ridder et al., 2015) Training in new skills with pairs better than alone so should have formative benefit (Martineau et al., 2013; Tolsgaard et al., 2013) Various theoretical and perceived benefits of formative peer assessment (Topping, 2009)	I think this should be a formative part of standard practice. It will improve acceptability and is in keeping with the purpose of this exercise.
Number of Participants	Reliability improves when multiple peer raters used e.g. >6 (Speyer et al., 2011) Weak evidence that smaller groups lead to more interactivity (Cho et al., 2016). Much of the literature is on pairs and triads (Chou et al., 2013; Tolsgaard et al., 2013) Our students often work in pairs and are timetabled as such.	Pairs or triads - No clear evidence for which is superior - Triads may not prove practical

Individual or group outcome	Cooperative learning theory suggests group outcome necessary to improve performance (Johnson and Johnson, 2009; Ladyshewsky, 2006) - Reduces freeloader effects, distributes responsibility Students dislike dependence on others' ability (Asghar, 2010) Practically difficult in a consultation skills setting	Formal individual outcome in terms of record, score, but the format could simulate joint outcome e.g. 'how will you two approach the same case?'
Timetabling	Must not be a burden (Finn and Garner, 2011). Must be space so that they can give immediate feedback (Bennett et al., 2012) Better to be integrated as part of wider teaching approach (van de Ridder et al., 2015)	Close liaison with module organisers. NPFS to take on responsibility of integrating it. Highlight that this is for students' own time e.g. during ward attachment, this can structure work Integrate to rest of clinical teaching
Amount of Training	Training is something that improves reliability (van de Ridder et al., 2015) but also acceptability (Kruidering-Hall et al., 2009). Students want training (Arnold et al., 2005) The exact amount of training required is not clear, but familiarity likely to be required (Burgess et al., 2015) It is potentially costly but will likely be worth it.	NPFS to provide introduction in core week and in modules. Ongoing training over the semester Video resources on how to Cheat sheets, Help files etc
Feedback tool structure	Reliability improves with rubrics in non-clinical (Orsmond et al., 1996; Panadero et al., 2013; van de Ridder et al., 2015), and perceived to be more useful by students in self assessment(Sargeant et al., 2011). Combined scores and qualitative data improves reliability of peer assessment (Li et al., 2016) and students value written comments.	OSCE-style rubric with space for free text comments Format to encourage discussion
Feedback tool medium	While it's felt to be a factor in feedback, no consistent results drawn in a a meta-analysis (van de Ridder et al., 2015). Paper may be more reliable than computer-based, but the groups are too heterogenous to be sure this result stands (Li et al., 2016) Paper easy to use and develop but hard to administrate Computer hard to develop and easier to administrate Computer may promote acceptability	I think this should be electronic if possible If not then paper format as part of Edinburgh Method Workbook or similar
Compulsory or Voluntary	Those who might benefit most engage least e.g. in feedback after summative assessment(Harrison et al., 2013) Voluntary participation may improve reliability (Li et al., 2016) Students split on what they would prefer in professionalism (Arnold et al., 2005) Evidence that peer assessment can identify the dunning-kruger effect in postgraduate setting (Violato and Lockyer, 2006) – may therefore let poor performers know they're not doing as well as they thought and encourage high performs. Some resistance to compulsory assessment	For discussion I would prefer compulsory as part of scheduled teaching with extras as students wish/incentives for completing To replace some feedback postcards

Number to be done	Deliberate practice likely to be important in simulation settings (Issenberg et al., 2005), and seems to be a key component in feedback giving generally (van de Ridder et al., 2015) Frequency improves performance(Martineau et al., 2013). Theoretical support e.g. in terms of cognitive development (Tolsgaard et al., 2016). Quality of feedback may deteriorate with time: risk of fatigue (Kruidering-Hall et al., 2009)	No maximum Format to include two attempts Encourage multiple attempts through multiple scheduled opportunities, record of attempts
Record to be kept?	No direct evidence comparing record vs no record for peer assessment, though e.g. CUSUM charts encourage performance in cannulation (Smith et al., 2012), and portfolios are desirable in formative assessment (Konopasek et al., 2016) Source for reflection, our evaluation, highlighting problems May impact on acceptability	Records should be kept, ideally electronically Ideally for student easy look up with a nice up-ticking graph
Advertisement/Publicity	No direct evidence on type Name likely important (Finn and Garner, 2011) Must be seen as valuable to proceed (Arnold et al., 2005). Should note this is an elaboration of common and useful practice (Duvivier et al., 2012; Tai et al., 2014) Care re: other timetables, assessments (Finn and Garner, 2011)	Publish the Edinburgh Method, integrate with modules and publicise at year wide meetings
Anonymous ratings?	Preferred in judgements of professionalism (Arnold et al., 2005; Kovach et al., 2009), but not practical in clinical skills Want to improve culture of feedback and groupwork – anonymity not likely to support this	Not anonymous
Who designs it?	Student involvement in design may help them understand it (Orsmond et al., 2002) but no other clear effect on efficacy. Important that students can use it so their informal input may help (Finn and Garner, 2011)	Design with students and MOs
How to deal with harm…	Oversight thought to be important by faculty (Kovach et al., 2009). Risk of harm clearly integral to the project planning	Clear guidance in advertising and central resources. Evaluate through feedback from students – direct and year-wide surveys etc

Summary

A formative peer assessment exercise using a structured checklist with comments (required). As part of agreed Edinburgh method of performing history and examination
Ideally handheld electronic format
Undertaken by pairs (or triads) and format to include at least attempts.
Integrated into standard teaching without taking away from existing staff led training
All students must at least take part during scheduled teaching – other requirements to be discussed. Perhaps establish semi-voluntary and reassess?
Record to be kept
Not anonymous
Significant training and advertising to be required

Bibliography

Arnold, L., Shue, C.K., Kritt, B., Ginsburg, S., Stern, D.T., 2005. Medical Students' Views on Peer Assessment of Professionalism. J. Gen. Intern. Med. 20, 819–824. https://doi.org/10.1111/j.1525-1497.2005.0162.x

Asghar, A., 2010. Reciprocal peer coaching and its use as a formative assessment strategy for first-year students. Assess. Eval. High. Educ. 35, 403–417. https://doi.org/10.1080/02602930902862834

Basehore, P.M., Pomerantz, S.C., Gentile, M., 2014. Reliability and benefits of medical student peers in rating complex clinical skills. Med. Teach. 36, 409–414. https://doi.org/10.3109/0142159X.2014.889287

Bennett, D., Kelly, M., O'Flynn, S., 2012. Framework for feedback: the peer mini-clinical examination as a formative assessment tool. Med. Educ. 46, 512–512. https://doi.org/10.1111/j.1365-2923.2012.04230.x

Bucknall, V., Sobic, E.M., Wood, H.L., Howlett, S.C., Taylor, R., Perkins, G.D., 2008. Peer assessment of resuscitation skills. Resuscitation 77, 211–215. https://doi.org/10.1016/j.resuscitation.2007.12.003

Burgess, A., Roberts, C., Black, K., Mellis, C., 2015. Student ability and learning experience in assessing peers alongside supervisors in the long case. Focus Health Prof. Educ. 2204-7662 16, 27–41.

Cho, Y., Je, S., Yoon, Y.S., Roh, H.R., Chang, C., Kang, H., Lim, T., 2016. The effect of peer-group size on the delivery of feedback in basic life support refresher training: a cluster randomized controlled trial. BMC Med. Educ. 16. https://doi.org/10.1186/s12909-016-0682-5

Chou, C.L., Masters, D.E., Chang, A., Kruidering, M., Hauer, K.E., 2013. Effects of longitudinal small-group learning on delivery and receipt of communication skills feedback. Med. Educ. 47, 1073–1079. https://doi.org/10.1111/medu.12246

Duvivier, R.J., van Geel, K., van Dalen, J., Scherpbier, A.J.J.A., van der Vleuten, C.P.M., 2012. Learning physical examination skills outside timetabled training sessions: what happens and why? Adv. Health Sci. Educ. 17, 339–355. https://doi.org/10.1007/s10459-011-9312-5

Finn, G.M., Garner, J., 2011. Twelve tips for implementing a successful peer assessment. Med. Teach. 33, 443–446. https://doi.org/10.3109/0142159X.2010.546909

Harrison, C.J., Konings, K.D., Molyneux, A., Schuwirth, L.W.T., Wass, V., van der Vleuten, C.P.M., 2013. Web-based feedback after summative assessment: how do students engage? Med. Educ. 47, 734–744. https://doi.org/10.1111/medu.12209

Hulsman, R.L., Peters, J.F., Fabriek, M., 2013. Peer-assessment of medical communication skills: The impact of students' personality, academic and social reputation on behavioural assessment. Patient Educ. Couns. 92, 346–354. https://doi.org/10.1016/j.pec.2013.07.004

Issenberg, S.B., Mcgaghie, W.C., Petrusa, E.R., Gordon, D.L., Scalese, R.J., 2005. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. Med. Teach. 27, 10–28. https://doi.org/10.1080/01421590500046924

Johnson, D.W., Johnson, R.T., 2009. An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning. Educ. Res. 38, 365–379. https://doi.org/10.3102/0013189X09339057

Konopasek, L., Norcini, J., Krupat, E., 2016. Focusing on the Formative: Building an Assessment System Aimed at Student Growth and Development. Acad. Med. 91, 1492–1497. https://doi.org/10.1097/ACM.0000000000001171

Kovach, R.A., Resch, D.S., Verhulst, S.J., 2009. Peer Assessment of Professionalism: A Five-Year Experience in Medical Clerkship. J. Gen. Intern. Med. 24, 742–746. https://doi.org/10.1007/s11606-009-0961-5

Kruidering-Hall, M., O'Sullivan, P.S., Chou, C.L., 2009. Teaching feedback to first-year medical students: long-term skill retention and accuracy of student self-assessment. J. Gen. Intern. Med. 24, 721–726. https://doi.org/10.1007/s11606-009-0983-z

Ladyshewsky, R.K., 2006. Building cooperation in peer coaching relationships: understanding the relationships between reward structure, learner preparedness, coaching skill and learner engagement. Physiotherapy 92, 4–10. https://doi.org/10.1016/j.physio.2005.11.005

Li, H., Xiong, Y., Zang, X., Kornhaber, M.L., Lyu, Y., Chung, K.S., Suen, H.K., 2016. Peer assessment in the digital age: a meta-analysis comparing peer and teacher ratings. Assess. Eval. High. Educ. 41, 245–264. https://doi.org/10.1080/02602938.2014.999746

Lurie, S.J., Lambert, D.R., Nofziger, A.C., Epstein, R.M., Grady-Weliky, T.A., 2007. Relationship between peer assessment during medical school, dean's letter rankings, and ratings by internship directors. J. Gen. Intern. Med. 22, 13–16. https://doi.org/10.1007/s11606-007-0117-4

Martineau, B., Mamede, S., St-Onge, C., Rikers, R.M., Schmidt, H.G., 2013. To observe or not to observe peers when learning physical examination skills; that is the question. BMC Med. Educ. 13, 55. https://doi.org/10.1186/1472-6920-13-55

McGarr, O., Clifford, A., amanda. clifford@ul.i., 2013. "Just enough to make you take it seriously": exploring students' attitudes towards peer assessment. High. Educ. 65, 677–693. https://doi.org/10.1007/s10734-012-9570-z

Orsmond, P., Merry, S., Reiling, K., 2002. The Use of Exemplars and Formative Feedback when Using Student Derived Marking Criteria in Peer and Self-assessment. Assess. Eval. High. Educ. 27, 309–323. https://doi.org/10.1080/0260293022000001337

Orsmond, P., Merry, S., Reiling, K., 1996. The Importance of Marking Criteria in the Use of Peer Assessment. Assess. Eval. High. Educ. 21, 239–250. https://doi.org/10.1080/0260293960210304

Panadero, E., Romero, M., Strijbos, J.-W., 2013. The impact of a rubric and friendship on peer assessment: Effects on construct validity, performance, and perceptions of fairness and comfort. Stud. Educ. Eval. 39, 195–203.

Rudy, D., Fejfar, M., Griffith, C., Wilson, J., 2001. Self- and peer assessment in a first-year communication and interviewing course. Eval. Health Prof. 24, 436–445. https://doi.org/10.1177/016327870102400405

Sargeant, J., Eva, K.W., Armson, H., Chesluk, B., Dornan, T., Holmboe, E., Lockyer, J.M., Loney, E., Mann, K.V., van der Vleuten, C.P.M., 2011. Features of assessment learners use to make informed self-assessments of clinical performance. Med. Educ. 45, 636–647. https://doi.org/10.1111/j.1365-2923.2010.03888.x

Smith, S.E., Tallentire, V.R., Spiller, J., Wood, S.M., Cameron, H.S., 2012. The educational value of using cumulative sum charts. Anaesthesia 67, 734–740. https://doi.org/10.1111/j.1365-2044.2012.07100.x

Speyer, R., Pilz, W., Van Der Kruis, J., Brunings, J.W., 2011. Reliability and validity of student peer assessment in medical education: a systematic review. Med. Teach. 33, e572-585. https://doi.org/10.3109/0142159X.2011.610835

Tai, J.H.-M., Haines, T.P., Canny, B.J., Molloy, E.K., 2014. A Study of Medical Students' Peer Learning on Clinical Placements: What They Have Taught Themselves to Do. J. Peer Learn. 7, 57–80.

Tolsgaard, M.G., Bjørck, S., Rasmussen, M.B., Gustafsson, A., Ringsted, C., 2013. Improving Efficiency of Clinical Skills Training: A Randomized Trial. J. Gen. Intern. Med. 28, 1072–1077. https://doi.org/10.1007/s11606-013-2378-4

Tolsgaard, M.G., Kulasegaram, K.M., Ringsted, C.V., 2016. Collaborative learning of clinical skills in health professions education: the why, how, when and for whom. Med. Educ. 50, 69–78. https://doi.org/10.1111/medu.12814

Topping, K.J., 2009. Peer Assessment. Theory Pract. 48, 20–27. https://doi.org/10.1080/00405840802577569

van de Ridder, J.M.M., McGaghie, W.C., Stokking, K.M., Ten Cate, O.T.J., 2015. Variables that affect the process and outcome of feedback, relevant for medical training: a meta-review. Med. Educ. 49, 658–673. https://doi.org/10.1111/medu.12744

Violato, C., Lockyer, J., 2006. Self and peer assessment of pediatricians, psychiatrists and medicine specialists: Implications for self-directed learning. Adv. Health Sci. Educ. 11, 235–244. https://doi.org/10.1007/s10459-005-5639-0

Appendix 5 – Ethics Application for Chapter 4

This is the ethical application form and associated documents for Chapter 4 on Peer Practice.

It includes:

- The ethics Application form
- (sub) Appendix 1a) the Crossover Design
- (sub) Appendix 1b) Exemplar Rubric for Peer Practice (the Common Criteria)
- (sub) Appendix 2) The Peer Learning Attitudes Questionnaire
- (sub) Appendix 3) Information form for interviews
- (sub) Appendix 4) Consent form for interviews
- (sub) Appendix 5) Adverts
- (sub) Appendix 6) Rubric for evaluating Peer Practice written comments
- The ethics approval certification
- Amendments to the ethics application

MVM Education Research (EREC) Project Application Form

Project Title

'Peer Practice' in Year 4 –Evaluation of Peer Assisted Learning of Clinical Skills

1. Study personnel

Name	Email	Phone No	Position
Dr Neill Storrar	Neill.storrar@Ed.ac.uk	242 9402	Clinical Fellow
Professor Helen Cameron	Helen.cameron@ed.ac.uk	242 6651	Professor of Medical Education
Dr David Hope	David.Hope@ed.ac.uk	242 6651	Fellow in Medical Education (Psychometrics)
Catherine Talbot	Catherine.talbot@ed.ac.uk	242 6651	CME Senior Administrator

State which staff member is taking overall responsibility for the conduct of this research and is the guarantor of the accuracy of this application. Please provide the title, position, and contact details for this individual. This individual would normally be a member of academic staff.

Dr Neill Storrar, Clinical Fellow in Medical Education, Centre for Medical Education, University of Edinburgh 49 Little France Crescent, Edinburgh EH16 4SB

2. Aims

State briefly the main reason for carrying out this research. Is a specific hypothesis being tested? What do you wish to find out? [most boxes will expand with text]

Aim

This study will investigate the effect of a method to promote peer assisted learning in year 4 of the medical school. This programme, called 'Peer Practice' focuses on learning 'consultation skills' – history and examination. We are investigating whether Peer Practice improves performance of these skills and how it affects the way students work and learn together.

3. Summary of research (300 words) [most boxes will expand with text]

Research Questions

1) Does Peer Practice improve performance in consultation skills?
2) Does Peer Practice change learning behaviour?
- confidence and ability in critiquing colleagues' performance
- readiness for teamwork

Study Outline

A doctor's technical skills – such as holding patient consultations - must be integrated with the ability to learn with others as part of a team (GMC, 2015). This project will assess whether efforts to promote peer learning between 4th year medical students can improve consultation skills and the ability to learn effectively with colleagues.

We will introduce a method called 'Peer Practice' into Year 4. Students will observe one another practising consultation skills and give feedback with a structured assessment rubric (the Peer Practice tool). They will do this in four modules (gastrointestinal, orthopaedics, cardiovascular and respiratory medicine).

Students are in a rotation system, where in Semester 1 half of students study one set of subjects, and half study another (Figure 1 in Appendix 1a). In Semester 2 the students rotate to the opposite subjects. Peer Practice will be introduced in Semester 2. Each student will therefore undertake Peer Practice in 2 of the 4 subjects: this is analogous to a crossover design and allows the impact of the method to be evaluated. Note that the Peer Practice tool will be *available* to all students for all modules, but will only be integrated into timetables and teaching for the modules in Semester 2. This open access is important for fairness to students, and to test the hypothesis that peer work (rather than simply providing clear standards for how consultation skills are assessed) improves performance. Peer Practice will not be introduced for the neurology or GP modules– these can act as additional controls.

The first question will be addressed using data from standard summative examinations.
The second question will be assessed using questionnaires and semi-structured interviews.

4. Funding source (if applicable)

This work will be undertaken as part of an MD project, and so researcher time will be supported by those funds.

5. Start and end dates

When are students being recruited, and when are they being asked to take part in any interviews or experiments? [see notes relating to exams in the guidance]

Start Date	Completion Date
July 2017	May 2018

6. Relevant literature review and references [boxes will expand with text]

This literature review will cover two areas. First, the rationale for peer assisted learning in this context and the outcome measurements we will use. Second, the importance and feasibility of crossover studies in medical education.

Peer assisted learning is increasingly promoted as a means of improving performance, approaches to learning and teamwork (Ten Cate and Durning 2007a). It is used in many contexts, but here we consider its role in teaching clinical skills, because this is an area of practice where postgraduate supervisors feel newly qualified doctors are underprepared (Tallentire *et al.* 2011). We know that students already learn with their peers in clinical environments (Tai *et al.* 2014), including with the specific aim of learning consultation skills: history and examinations (Duvivier *et al.* 2012). Some studies have assessed the efficacy of peer learning compared with individual learning, but these are generally in classroom or laboratory-type settings (Tai, Molloy, *et al.* 2016). For example, a randomised study of 49 students assigned to individual or paired practice of consultation skills demonstrated improved performance in the paired group (Tolsgaard *et al.* 2013). Giving peers structured feedback also improves your own performance (Lawton and MacDougall 2004, Basehore *et al.* 2014). Experience of learning together in non-clinical contexts makes students more comfortable with doing so in the future (Parmelee *et al.* 2009), and improved confidence in critiquing colleagues is a potential benefit in the clinical setting too (Martineau *et al.* 2013).

Our outcomes will be assessed using assessment performance data, questionnaires and interviews to explore student perceptions. Clinical performance is routinely assessed using Objective Structured Clinical Examinations, or OSCEs (Harden and Gleeson 1979). Tools to measure the willingness to learn together have been adapted from two sources. The 'Readiness for Interprofessional Learning Scale' was designed to assess preparation for working between healthcare professions – medical, dental, nursing, physiotherapy students (Parsell and Bligh 1999). It has been found to be reliable in other contexts (McFadyen *et al.* 2010) and seems applicable to assessments of team work for physicians (Havyer *et al.* 2015). Another inventory looks at how teams perform in 'Team Based Learning', a classroom form of peer work that we will adapt to this setting (Parmelee *et al.* 2009). The semi-structured interviews will use grounded theory (Glaser and Strauss 1967) to develop a model of how students learn consultation skills together. This builds on a prior research project (in progress: MVM SEC Approval 2016/22).

All of this supports further use of peer learning of consultation skills in a clinical environment, but there remains *equipoise* about whether it will be effective in real clinical contexts. Many other factors such as alternative teaching methods, practicality of using the tool in busy clinical environments and acceptability of peer teaching for students might limit or negate the effects of such method (Bennett *et al.* 2012, Cook and West 2013).

Before committing to a potentially expensive teaching method, we should therefore ask whether it works in that context through approaches like 'practical trials' (Tolsgaard *et al.* 2017). These intend to inform real practice by studying interventions in real-life settings with broad inclusion criteria using comparative methods, such as crossover trials. Crossover trials – where each cohort receives the intervention in a different order - are an attractive method for educational studies for several reasons. First, as a controlled trial it allows assessment of efficacy to take place. Second, since each participant experiences both the intervention and the alternative; there is intrinsic fairness. Third, because all students have the intervention and the control, the study's power is increased (Pocock 1999).

For these reasons, crossover studies have been widely used in educational studies, for example in year-wide studies of the value of problem-based learning (Johnston *et al.* 2009). The method has also been used for teaching in the clinical environment, such as a study where all 123 students on a cardiology attachment were assessed on their ability to review drug charts with and without specialist training (Holderried *et al.* 2014). This is therefore an established and valuable method that has direct application to this context and overcomes several possible practical and ethical issues. The design outlined above and in Appendix 1a is very similar to a classical crossover design since students all do Peer Practice with a different 'order' based on module rotation. The design including 'control groups' in neurology and GP will allow us to detect and account for possible confounders such as maturation effects. Such ordering/maturation effects in the Year 4 OSCE with existing teaching are not thought to be strong (based on prior review of assessment data by DH). As educational innovators we can take advantage of this to ensure resources are used wisely and problems for students identified.

Project Development and Curriculum Governance

The Peer Practice method and the use of a crossover experimental design to explore its effectiveness were discussed in detail at the Year 4 Committee meeting on 25th April 2017. The issues of equipoise, fairness and how students will respond to Peer Practice were raised. It was noted that

- the project entails a small change to teaching
- the fairness of the study is augmented by the equal weighting of each module in the OSCE
- Peer Practice is voluntary and formative
- The design allows both efficacy and acceptability data to be collected

The Year 4 Committee concluded that there is evidence to support peer assisted learning of clinical skills, and both precedent and rationale to evaluate it through this 'crossover' design. They approved the introduction of Peer Practice and commended the experimental design of the evaluation aimed at exploring both the efficacy of the method and student satisfaction.

We are seeking the MVMSEC's approval for the study design and to research the effect of this change in teaching through anonymous analysis of examination results, and the response of students to Peer Practice through interviews and questionnaires, for wider dissemination in research. This level of analysis will provide additional assurances about the impact of the teaching so it does not cause unexpected and undocumented issues for students.

References

Basehore, P.M., Pomerantz, S.C., Gentile, M., 2014. Reliability and benefits of medical student peers in rating complex clinical skills. Med. Teach. 36, 409–414. doi:10.3109/0142159X.2014.889287

Bennett, D., Kelly, M., O'Flynn, S., 2012. Framework for feedback: the peer mini-clinical examination as a formative assessment tool. Med. Educ. 46, 512–512. doi:10.1111/j.1365-2923.2012.04230.x

Cook, D.A., West, C.P., 2013. Perspective: Reconsidering the Focus on "Outcomes Research" in Medical Education: A Cautionary Note. Acad. Med. 88, 162–167. doi:10.1097/ACM.0b013e31827c3d78

Duvivier, R.J., van Geel, K., van Dalen, J., Scherpbier, A.J.J.A., van der Vleuten, C.P.M., 2012. Learning physical examination skills outside timetabled training sessions: what happens and why? Adv. Heal. Sci. Educ. 17, 339–355. doi:10.1007/s10459-011-9312-5

Gallegos, P.J., Peeters, J.M., 2011. A measure of teamwork perceptions for team-based learning. Curr. Pharm. Teach. Learn. 3, 30–35. doi:10.1016/j.cptl.2010.10.004

Glaser, B.G., Strauss, A.L., 1967. The discovery of grounded theory: strategies for qualitative research, Observations. Aldine PubCo, Chicago : New York.

Harden, R.M., Gleeson, F.A., 1979. Assessment of clinical competence using an objective structured clinical examination (OSCE). Med. Educ. 13, 39–54. doi:10.1111/j.1365-2923.1979.tb00918.x

Havyer, R.D., Nelson, D.R., Wingo, M.T., Comfere, N.I., Halvorsen, A.J., McDonald, F.S., Reed, D.A., 2015. Addressing the Interprofessional Collaboration Competencies of the Association of American Medical Colleges. Acad. Med. XX, 1. doi:10.1097/ACM.0000000000001053

Holderried, F., Heine, D., Wagner, R., Mahling, M., Fenik, Y., Herrmann-Werner, A., Riessen, R., Weyrich, P., Zipfel, S., Celebi, N., Baradaran, H.R., 2014. Problem-Based Training

Improves Recognition of Patient Hazards by Advanced Medical Students during Chart Review: A Randomized Controlled Crossover Study. PLoS One 9, e89198. doi:10.1371/journal.pone.0089198

Johnston, J.M., Schooling, C.M., Leung, G.M., 2009. A randomised-controlled trial of two educational modes for undergraduate evidence-based medicine learning in Asia. BMC Med. Educ. 9, 63. doi:10.1186/1472-6920-9-63

Lawton, B., MacDougall, C., 2004. Developing clinical skills: a simple and practical tool. Med. Educ. 38, 1198–1199. doi:10.1111/j.1365-2929.2004.01996.x

Martineau, B., Mamede, S., St-Onge, C., Rikers, R.M., Schmidt, H.G., 2013. To observe or not to observe peers when learning physical examination skills; that is the question. BMC Med. Educ. 13, 55. doi:10.1186/1472-6920-13-55

McFadyen, A.K., Webster, V.S., Maclaren, W.M., O'neill, M.A., 2010. Interprofessional attitudes and perceptions: Results from a longitudinal controlled trial of pre-registration health and social care students in Scotland. J. Interprof. Care 24, 549–564. doi:10.3109/13561820903520369

Parmelee, D.X., DeStephen, D., Borges, N.J., 2009. Medical students' attitudes about team-based learning in a pre-clinical curriculum. Med. Educ. Online 14, 1. doi:10.3885/meo.2009.Res00280

Parsell, G., Bligh, J., 1999. The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). Med. Educ. 95–100.

Pocock, S.J., 1999. Chapter 8 - Crossover Trials, in: Clinical Trials - A Practical Approach. John Wiley & Sons, Ltd, pp. 110–122.

Tai, J., Molloy, E., Haines, T., Canny, B., 2016. Same-level peer-assisted learning in medical clinical placements: a narrative systematic review. Med. Educ. 50, 469–484. doi:10.1111/medu.12898

Tai, J.H.-M., Haines, T.P., Canny, B.J., Molloy, E.K., 2014. A Study of Medical Students' Peer Learning on Clinical Placements: What They Have Taught Themselves to Do. J. Peer Learn. 7, 57–80.

Tallentire, V.R., Smith, S.E., Wylde, K., Cameron, H.S., 2011. Are medical graduates ready to face the challenges of Foundation training? Postgrad. Med. J. 87, 590–595. doi:10.1136/pgmj.2010.115659

Ten Cate, O., Durning, S., 2007. Peer teaching in medical education: twelve reasons to move

from theory to practice. Med. Teach. 29, 591–599. doi:10.1080/01421590701606799

Tolsgaard, M.G., Bjørck, S., Rasmussen, M.B., Gustafsson, A., Ringsted, C., 2013. Improving Efficiency of Clinical Skills Training: A Randomized Trial. J. Gen. Intern. Med. 28, 1072–1077. doi:10.1007/s11606-013-2378-4

Tolsgaard, M.G., Kulasegaram, K.M., Ringsted, C., 2017. Practical trials in medical education: linking theory, practice and decision making. Med. Educ. 51, 22–30. doi:10.1111/medu.13135

7. Details of pilot studies and validation studies (e.g. questionnaires)

This project builds on an existing practice where students volunteer or are asked to review patients in pairs or triads: it is therefore a formalisation and expansion of routine educational practice.

The lead author has piloted the Peer Practice tool with year 4 students in a small scale teaching session in the Y4 orthopaedics block in May 2017, and received useful feedback on feasibility and fairness.

OSCE scores are routinely collected. To test whether our sample size is appropriate, we performed a power calculation for an unpaired t-test of mean OSCE scores between groups. A medium effect size of 0.63 was found in a similar trial (Tolsgaard *et al.* 2013). If we took a more conservative effect size of 0.5, than to have 80% chance of detecting this at alpha of 0.05 we would need 64 students in each group. There are typically 200 to 250 students in year 4. If the effect size is smaller, the study will not reliably detect a difference. However, this would be useful information because it would demonstrate that such interventions were not useful enough to justify further time and resource investment. We will also compare station fail rates between module stations, and again are powered to detect medium effect sizes.

For the questionnaires, the RIPLS and the team effectiveness questionnaire have been well studied in other contexts as stated above. For example the initial RIPLS publication found internal consistency (alpha coefficient) of 0.9 (Parsell and Bligh 1999), and the team effectiveness questionnaire reliability was 0.93 when measured in a related study (Gallegos and Peeters 2011). We will pilot our version of these scales with year 5 medical students to confirm its basic applicability to this context.

The interviews follow on from a previous project interviewing year 4 students about their experience of peer learning (MVM SEC Approval 2016/22).

8. Methods/research protocol (please review guidance notes carefully)

Please include copies of any questionnaires that are being used (as an attachment or appendix). If checklists are being used in interviews, please provide them. Include details of all demographic details you will record about subjects and any other information that might be considered highly personal. Expand this section as necessary.

Students undertaking Peer Practice will use a check-listed based rubric to evaluate one another's consultation skills. The feedback will be recorded electronically (or on paper if electronic format not available). Opportunities to do this will be made in the modules, and this will be a recommended activity. An exemplar is included in Appendix 1b – this is the template we will use to write the electronic format for use on computers, tablets and mobile devices. The records will be automatically collected and stored on the university servers via secure software that the medical school uses for other assessments (Pebble Pad, Practique).

It is expected that most of the c. 250 students will fill in several of these and so it is likely that more than 1000 records will be available. Quantitative data will be available via the electronic records system on record outcomes, number of records completed and timing of completion. This will allow us to correlate anonymised student ratings with summative assessment and evaluate the patterns of learning.

A subset of these will be analysed for the content of written comments to see whether students are able to give constructive comments using an existing rubric (appendix 6). We will use a computer to randomly select 30 records from each of the lowest, middle and highest quintiles based on OSCE performance. We will evaluate these for correlation between feedback content and later performance.

In this first year of use, we will gather data on year 4 students' views of this to help identify the value of continuing Peer Practice in the long-term. We will undertake two rounds of questionnaires – the first in semester 1 and the second in semester 2. These will use the questionnaire shown in Appendix 2. This will identify any change in views based on experience with Peer Practice.
Students will also be invited to give feedback on the process in person via individual interviews advertised during the monthly module teaching weeks in the Year 4 timetable [advert]. They will be asked open questions about their experience of the programme [Appendix] so that we can understand the way students learn together in greater depth.

9. External review

Who has provided external review of the proposed research? Please attach any reviewer comments.

Dr Derek Jones, Academic Coordinator on the MSc in Clinical Education, has reviewed the proposal and provided the following substantive comments:

1) provide clarity of the selection and stratification procedures for analysis of written comments in the Peer Practice Records (section 8)
-> computerised random selection stated, stratification outlined.

2) Comments on content of information sheet and consent form
-> Expanded detail in the information sheet regarding publication and ability to withdraw consent.
-> Removed comment from consent form 'I will answer as openly and honestly as possible…' in case viewed as pressuring students

Other comments
– answers to questions 11 b and 11 c agreed
- Dealing with possible distress or harm in section 15 – process said to be 'robust'.

10. Proposed analysis

Provide details of how the analysis will be undertaken. Explain why you have chosen particular sample size(s). If you are intending to include all of a target group, justify why you have not chosen a random (or another method) of sampling.

The research questions will guide the analysis.

Question 1 – Does Peer Practice improve performance in consultation skills?

The main analysis will be comparison of mean scores between groups, and number of failing students in the relevant OSCE stations.

Sub-analysis will include correlation with previous academic score (do weaker students benefit from Peer Practice more than stronger students?), correlation with frequency and content of Peer Practice records completed (via electronic records). Note that whole year group evaluation is important because of concerns about statistical power, and this data is routinely collected.

Neill Storrar will undertake the statistical analysis with guidance from David Hope (Supervisor for NS' MD) as required.

Question 2 – Does Peer Practice change learning behaviour?

- The analysis will involve comparison of item scores and views before and after the Peer Practice is introduced to investigate its effects on how students learn with one another. We will invite the whole year to fill in questionnaires because we want to collect all negative and positive views on the process and identify any unintended adverse effects on teamwork.
- For individual interviews, we will use in-depth semi-structured interviews using grounded theory to explore how students learn together (Glaser and Strauss 1967). Consistent with grounded theory the sample size cannot be entirely pre-specified but given the timeframe we anticipate interviewing perhaps 15 students.

11. Recruitment

(a) Describe how subjects are to be recruited. Please provide copies of any advertising material, posters, emails etc. If slides are be used, please provide copies (attach as necessary).

For interviews and questionnaire, an advertising slide will be included at the end of lectures, and notices placed on Learn (the replacement for EEMeC), and on posters in the medical school (see appendix). Students will not be directly emailed about the project unless they have already contacted the researcher expressing interest in participating. Information leaflets will be available on Learn but also sent out to any participants.

(b) Do you think there is a possibility that a reasonable person might judge that students may feel pressured into taking part? Yes ☐ No ☒

(c) Is it clear that a student's decision whether to take part or not is private (that is that other students cannot work out whether another student has declined to volunteer).
Yes ☒ No ☐

If the answer to the above question is no, please justify what you propose.

(d) Can you confirm that recruitment is not taking place within a lecture or seminar (rather than at the end of a teaching session, via a slide or poster)
Yes ☒ No ☐

(e) Please provide a copy of the information sheet and consent form (if appropriate). If written consent is not being used, explain why you believe this approach is appropriate to your study.

Written consent will be sought for the interviews – see appendices. Questionnaire invitation will include a statement that completion will be taken as implicit consent (standard practice). The completed Peer Practice routine records will be collected for the students' own use and review by their personal tutors. Analysis of these records will be undertaken to audit the scope and quality of the implementation of Peer Practice in a de-identified manner, and is consistent with the audit of other routinely collected data such as feedback from students or examination scores.

12. Data handling

Describe how you are complying with the relevant legislation. In particular:

(a) Which member of staff is the data guardian?

Dr Neill Storrar

(b) Describe *how* data is being kept including details of *how* data is de-identified or made anonymous.

Data from Peer Practice records, OSCEs and questionnaires will be de-identified by converting matriculation numbers into a new code number. The key for this will be held in a password protected file in a secure digital folder.
Consent forms (which are not anonymous) will be held in secure locked facilities in the Chancellor's Building
Interviews will be recorded digitally and transferred immediately to encrypted password protected storage in the university network accessible only by the researcher, supervisors and senior administrator Catherine Talbot. Files will be named by sequence number rather than student identifier, and a password protected look up list held in a separate digital folder. At transcription names of participants or referents will be removed and replaced with pseudonyms. Transcription will be via a secure commercial transcription company with a track-record for use in this institution (1st Class Secretarial Services) with appropriate confidentiality agreements.

(c) How long is the data being kept for?

Per the university's research data management and retention policies, data will be kept for a minimum of 3 years or until the research, write up and publication is complete, whichever is longer.

(d) How can subjects withdraw consent (at all stages of the project)?

Written or email contact to the researcher, supervisor or external contact as outlined in the consent document. This will result in destruction of recorded data and transcripts and removal of content from any data analysis or write up that has occurred.

For **any identifiable data**:

(a) Are all machines password protected with robust passwords, or other security features? If using laptops are all the identifiable files encrypted. Yes ☒ No ☐

(b) How are paper records being kept and stored. What security measures and backup procedures are in place?

Paper records are kept in a locked cabinet in a locked office. Digital scans of these documents will be held in a password protected file with secure storage as a backup. The files on the university network are backed up regularly.

(c) Do you have a robust data backup strategy? Yes ☒ No ☐

13. Video or audio recordings

Does your research include the use of video or audio recordings? Yes ☒ No ☐

If yes, describe how the data is being kept secure, and access controlled. Are codes used for participants? How long will the raw data be kept for. How is the issue of withdrawal of consent in-group videos being dealt with? How are the files encrypted?

See description in Question 12 – audio files will be transferred to secure encrypted digital storage on the university network, with alias data in a separate look up list. Raw data will be kept in accordance with the data policy above.

14. Training of interviewers

If your project involves interviews, and sensitive issues are being covered, what training have the relevant staff had. How has their competence been assessed?

The lead researcher NS has undergone initial training with DH as part of his post at the CME, and undertaken many interviews already as part of a prior project. He has had further training in interviewing through a course in qualitative research method at the Wellcome Trust Clinical Research Facility. Additionally, NS is experienced in handling complex, difficult and confidential information as part of his clinical work.

15. Potential Distress or Harm

(a) What possibilities for causing distress or embarrassment do you think are present? What arrangements have you made to deal with these issues? If you are assuming use of support services or are directing students to support services, have you (or will you) inform these services? Have you discussed these issues with the Dean of Pastoral Affairs?

Here we focus on efforts to reduce any distress or embarrassment from participation in the interviews and questionnaires.

We are asking students about their experience of the Peer Practice and how they work with other students. We are not seeking data on unprofessional or illegal behaviour and it is extremely unlikely that participants will ask to talk about such subjects. At consenting for interview, it will be made clear to participants that any reports of identifiable unprofessional or illegal behaviour would necessitate a breach of confidentiality: normal professional guidelines for reporting such behaviour will be followed. The interviews may cover mildly sensitive subjects around peer support and the challenges of medical school, but we do not anticipate distress or embarrassment being an issue. Contact details for appropriate support services is included in the information leaflet that students will be given before and at the interviews.

In the event of any significant negative institutional issues being raised, for example related to bullying, this will be escalated to the appropriate senior professional. In the first instance this would be Dr David Kluth, Head of Undergraduate Medical Teaching. Dr Kluth is external to this research team. Dr Kluth will also be available as an external contact if participants want to approach someone external to the project with concerns.

Any concerns students may have related to the Peer Practice teaching method itself are in the remit of existing measures to support students on clinical attachments. Clinical teaching already involves routine use of informal peer feedback, such as when voluntarily reviewing patients in pairs. The issue of the fairness of the crossover design is covered in the study outline and literature review above, and was discussed in the Year 4 Committee meeting.

(b) Studies that involve considerable time, or that they may cause students embarrassment or to reflect on academic failure should not take place close (2 weeks) of important exams. How are you dealing with this issue?

At invitation to interview we will ensure that students are not scheduled for important assessments in the following 2 weeks – this will be done by confirming with the students and consulting the curriculum/timetable on EEMeC/Learn.

Interviews and questionnaires will not be conducted two weeks prior to semester and end of year exams.

16. Are you using deception as part of your experiment?

If the answer is yes, please explain and justify.

No

17. Probity and professional misconduct

Are you collecting data relating to activities that are either illegal or that may call into question a subject's fitness to practice; or information that might call into question the fitness to practice of others? Yes ☐ No ☒

If the answer is yes, we would expect a detailed justification, including details of how you intend to deal with these issues. Based on previous examples of such research we would likely need to take expert legal advice from the UoE. Review of such projects is likely to take longer than one month. We would expect that you have discussed whese issue with senior MVM staff prior to submission.

See above – this is not relevant to the topic of this study.

18. Potential conflicts between staff roles as researchers and examiners.

Can you confirm that those researchers who are aware of whether students choose to provide consent and take part in the study (or not), or who have access to identifiable research participant material, are not involved in any subjective student assessment (tutor reports, professionalism reports, CPE, vivas etc). Yes ☐ No ☒

If you are not able to comply with this, please outline a case for how you propose to deal with this issue.

The researchers will ensure that any students who are involved in the study will not be examined in the future in any of these identifiable subjective student assessments. Examinee lists will be screened to ensure the researcher does not assess these students. The relatively small number of participants will make this feasible.

19. Informing study subjects of results

Will and how subjects be informed of the results of the study? Who is taking responsibility for this?

Students will be asked at the interview whether they wish to be contacted when study results are available. At thesis completion and paper publication the lead researcher will email those who opt in with a link to the research findings.

20. Will you make your data available to other researchers?

Will the anonymous data be made available to other researchers in a form that is usable to them? What conditions will you attach?

The nature of interviews makes maintenance of confidentiality difficult if whole anonymised transcripts are made available: we will therefore not release this data. However, any quantitative data that is collected and the details of coding of qualitative data will be available on request.

21. Briefly describe any payments or other inducements you are offering students to take part in this study?

We will not offer a financial reward for participation, but will provide refreshments for participants.

[Ethics Application sub Appendices]

1) a) Crossover design b) Exemplar Rubric for Use in Peer Practice
2) Questionnaires
3) Consent form for interviews
4) Information sheet for interviews
5) Adverts for interview
6) Rubric for evaluating Peer Practice written comments

(sub) Appendix 1a – Crossover Design

		Semester 1	Semester 2	OSCE
Cohort 1			Peer Practice	
Cohort 2			Peer Practice	

Two cohorts of students take subjects in different orders in each semester e.g. cardiology in Yellow, GI in Blue. The crossover design (introducing Peer Practice in Semester 2) was agreed so that module staff could discern the effect of the method on performance for each subject.

(sub) Appendix 1b – Common Criteria - Exemplar Rubric for use in Peer Practice

Rubrics such as this will provide students with criteria for learning history-taking and examination skills in major medical specialties such as the cardiovascular system. Students will also give each other feedback which can be recorded in their learning portfolios for review and future use.

Clinical Exam Mark Sheet

CARDIOVASCULAR EXAMINATION

Starting Your Examination	**General Examination**
⓪①② Appropriate attire and hand wash	⓪①② Around the bed – O2, GTN, ECG…
⓪①② Introduces self by name and position	⓪①② Comfort/respiratory effort
⓪①② Asks patient's name and confirms DOB	⓪①② Hands: clubbing, stigmata endocarditis, xanthomata, capillary refill
⓪①② Verbal consent and asks about pain	⓪①② Face**:** pallor, arcus, cyanosis…
⓪①② Exposure – patient lying at 45 deg	
Pulses	Palpation
⓪①② Radial (rate and rhythm)	⓪①② RV Heaves
⓪①② Brachial (force and character)	⓪①② Thrills
⓪①② Collapsing Pulse	⓪①② Apex Beat
⓪①② Carotid	Auscultation
⓪①② JVP (**at 45^0**) +/- hepato-jugular reflex	⓪①② All 4 valve areas
⓪①② Femoral/distal pulses/bruits	⓪①② Times with carotid pulse
Precordium	⓪①② Radiation – neck and axilla
Inspection	⓪①② Manoeuvres – for AR and MS
⓪①② Pulsations, scars, implanted devices…	⓪①② Lung Bases
Finishing	**Discretionary Marks**
⓪①② Thanks Patient	⓪①② Fluent Examination
⓪①② Summary + tests: Obs, ECG…	⓪①② Clear Communication with Patient

Overall performance *e.g. say something nice, say something helpful*
Things to follow up: *e.g. make test for clubbing more obvious, check with SpR about JVP*

(sub) Appendix 2 – Questionnaire [Peer Learning Attitudes Survey]

Likert Scales 0 to 5 except additional questions (enter a number)

Team-work and Collaboration

Learning with other students will help me become a more effective member of a health care team

Patients would ultimately benefit if medical students worked together to solve patient problems

Shared learning with other medical students will increase my ability to understand clinical problems

Learning with other medical students before qualification would improve relationships after qualification

Consultation skills (history and examination) should be learned with other medical students

Shared learning will help me to think positively about other professionals

For peer learning to work, students need to trust and respect each other

Peer learning skills are essential for all health care students to learn

Peer learning will help me to understand my own limitations

Professional Identity

I don't want to waste my time learning with other medical students

It is not necessary for medical students to learn together

Clinical problem-solving skills can only be learned from senior teachers

Shared learning with other medical students will help me to communicate better with patients and other professionals

I would welcome the opportunity to learn clinical medicine with other students

Peer learning will help to clarify the nature of patient problems

Peer learning before qualification will help me become a better team worker

Satisfaction with Feedback from Peers

I have found that my peers have been fair in judging my skills, knowledge or performance

I have found that peer feedback motivates me to work harder

I have generally liked the use of peer feedback as part of my learning experience

I have found that peer feedback motivates me to work more collaboratively

I have found it easy to give feedback to my peers

Team Impact on Clinical Reasoning Ability

I have found that working with other students has helped me become better at problem solving

I have found that students make good clinical decisions

Discussions with peers have improved my ability to think through a problem

Additional Questions
On average during the last 4 weeks, how many times do you think you have taken a history or performed an examination in each of the following circumstances? [0 // 1-3 // 4-6 //8-10 //>10]
With real patients with a tutor/doctor present
With real patients on your own
With real patients with another student
With another student acting as patient with no tutor/doctor present
Other settings (please specify)

(sub) Appendix 3 – Information Sheet for Interview

THE UNIVERSITY of EDINBURGH
Edinburgh Medical School

Centre for Medical Education
The University of Edinburgh
The Chancellor's Building
49 Little France Crescent
Edinburgh EH16 4SB

Tel: 0131 242 6651

What is the research for?

We are interested in understanding the value, of Peer Practice, a form of peer assisted learning in Year 4 of the medical school. We would like to know what your experience of using this method has been, whether you found it useful and what its strengths and weaknesses are. We are also interested in how it has influenced your work with other students. This will help us decide how it should be developed and indeed whether it has a role in the future.

What would happen if I take part?

Participants will be interviewed individually and in private. This is to allow an in depth discussion whilst maintaining confidentiality. The interviews would take place at a time and place convenient to you that does not impact on your educational commitments. Interviews should take no more than 1 hour. Refreshments will be provided.

Your participation is entirely optional and your decision to take part will not be revealed to anyone.

Who is doing this research?

This is a study as part of my work as a Clinical Fellow in Medical Education at the Centre for Medical Education. It is being supervised by Professor Helen Cameron (Professor of Medical Education) and Dr David Hope (Fellow in Medical Education - Psychometrics) and is organised by the CME.

Would the interview be confidential?

Yes, this interview would be treated as confidential. Confidentiality would only be breached in the event of serious concerns regarding identifiable professional misconduct or illegal

activity. Any positive or negative aspects of the subject could, however, be discussed in general terms. This is in keeping with normal educational procedure. Transcripts will be made anonymous and not shared with anyone outside of the research group. Recordings and notes will be destroyed when they are no longer required for this project. You can withdraw from the project at any time and you do not need to give a reason for doing so.

What should I do if I have concerns?

We do not expect any distress from participation in the study, but if there are any concerns you can speak to the researchers (details below), a staff member not involved in the project (David Kluth, david.kluth@ed.ac.uk), your personal tutor or the University Counselling Services (http://www.ed.ac.uk/student-counselling).

Will I be able to see the results?

The results of this may be published as research findings, including anonymised quotes, in journal articles, book chapters, on the world wide web or in a thesis / dissertation. If you would like to find out the results of the study you can contact the researchers using the details below, or request that we contact you once research is published.

Thank you very much indeed for considering this invitation; all input would be most welcome.

Best wishes

Neill Storrar
Clinical Fellow in Medical Education

Contact details

Dr Neill Storrar – neill.storrar@ed.ac.uk
Professor Cameron – helen.cameron@ed.ac.uk
Dr David Hope – david.hope@ed.ac.uk

Centre for Medical Education
Chancellor's Building
49 Little France Crescent,
Edinburgh, EH16 4SB

Telephone - 0131 242 6651

(sub) Appendix 4 – Consent form for Interviews

THE UNIVERSITY OF EDINBURGH

CENTRE FOR MEDICAL EDUCATION

INTERVIEW & FOCUS GROUP CONSENT FORM

Project Title: **The role of Peer Practice in Learning Clinical Skills**

Date and time: _____

Researcher: _____

Participant name: _____

& Contact details: _____

_____

1. I agree to participate in an interview / focus group undertaken by The University of Edinburgh Centre for Medical Education and their research collaborators.

2. I have been given a full explanation of the nature, purpose and likely duration of the interview / focus group, and have been given the opportunity to ask questions about these.

3. I have been assured that my participation is entirely voluntary and I understand that I am free to withdraw my participation at any time without needing to justify my decision. I can also ask afterwards for specific comments not to be used in the research.

4. I do not in any way feel pressured into participating in this research.

5. I understand that notes will be taken and the interview / focus group will be audio-recorded and transcribed. These will be treated in strictest confidence and will only be accessible to the research team. Confidentiality would only be breached in the event of serious concerns regarding identifiable professional misconduct or illegal activity. Any positive or negative aspects of learning environment could, however, be discussed in general terms. This is in keeping with normal educational procedure. Data will be destroyed when no-longer required for the research

6. I understand that anonymous data from this interview / focus group may be published as research findings, including anonymised quotes, in journal articles, book chapters, on the world wide web or in a thesis / dissertation. I am aware that I can see any such material upon request.

7. I understand that I can withdraw consent at any time by notifying Dr Neill Storrar (neill.storrar@ed.ac.uk).

Signed by the Participant: _____

Date: _____

(sub) Appendix 5 - Adverts

Notice for Learn Discussion Boards – Does Peer Practice Work?

A method for practising history taking and examination skills has been introduced into Year 4 called Peer Practice [link]

We really want to know what your experience of it has been.

- Do you use it?
- Does it work?
- Should it change?
- Has it affected the way you work with other students?
- Has it affected how you learn with patients?

Please get in touch with neill.storrar@ed.ac.uk to take part in this research

Notice for End of lectures Is Peer Practice helpful?

Peer Practice is meant to help you learn

Does it work?
Do you use it?
Does it affect how you work?
How should it change?

I would like to know

Please get in touch to take part in this research
Neill.storrar@ed.ac.uk
Clinical Fellow in Medical Education
0131 242 9402

Peer Practice

(sub) Appendix 6 - Rubric for evaluating Peer Practice written comments

This rubric was developed for assessing the quality of comments in previous written feedback records

ID
The examiner has adhered to the instructions on how to use the boxes and comment section
Comments are detailed
Comments are empathic and non-judgmental
Feedback indicates how to improve
The student should find this feedback satisfying
The feedback is legible - if no comments were left leave blank [yes/no] [omit this item if record electronic]
The examiner left at least one comment [yes/no]
The sheet was completely blank [yes/no]

(sub) Appendix 7 – Approval of Ethics Application

Subject	**Re: Educational Research - Ethics Submission**
From	MUIR Karen
To	STORRAR Neill
Cc	HOPE David
Sent	09 June 2017 12:48

MVM Student Ethics Committee Application 2017/10
'Peer Practice' in Year 4 - Evaluation of Peer Assisted Learning of Clinical Skills
Dr Neill Storrar et al
Dear Dr Storrar,
I am pleased to confirm the above application has been approved by the MVM Student Ethics Committee. The approval number is 2017/10.
Best Wishes
Karen

_____

Karen Muir
Dermatology Administrator /
Secretary to Professor Jonathan Rees FMedSci
Grant Chair of Dermatology, University of Edinburgh

www.reestheskin.so — medicine and education
http://www.reestheskin.me — about Prof Rees and some other stuff
www.skincancer909.com — for an open access textbook of skin cancer

Dermatology, Rm 4.018. Lauriston Building
Lauriston Place, EDINBURGH, EH3 9HA
tel: 00 (0)131 536 2041

On 6 Jun 2017, at 15:54, STORRAR Neill <neill.storrar@ed.ac.uk> wrote:
Dear Karen,

I am applying for ethical approval from the MVM SEC for an education research project that would be due to start in Academic Year 2017-2018.

I've attached the application form which I trust is self-explanatory, but please let me know if there is any further information required.

Many thanks and best wishes,

Neill

Dr Neill Storrar
Clinical Fellow
Centre for Medical Education
neill.storrar@ed.ac.uk

0131 242 9402

<Storrar MVM SEC Project Application - June 2017 - Peer Practice.docx>

(sub) Appendix 8 – Amendments to Ethics for Peer Practice

Following the ethics application detailed in 1.5, an addendum was added to use a voucher scheme to improve survey response rates. The correspondence with Professor Jonathan Rees, Chair of the MVM Student Ethics Committee is reproduced here.

Subject	**Re: Advice about further addendum to ethics submission**
From	REES Jonathan
To	STORRAR Neill; MUIR Karen
Sent	09 April 2018 10:21

Neill, after having spoken to you, what you propose seems quite acceptable.
We will keep this email on file.
Jonathan

Professor Jonathan Rees FMedSci
Grant Chair of Dermatology
Edinburgh Medical School
University of Edinburgh

See the new version of www.skincancer909.com

Learn dermatology!
www.reestheskin.me/teaching — learn dermatology
www.reestheskin.me/picgal/ — open image library of skin cancer
www.skincancer909.com — for an open access textbook of skin cancer

About me
www.reestheskin.me — about me, and some other stuff
www.reestheskinblog.me — my blog mainly about medicine and education
@reestheskin

Postal address:
Dermatology, Rm 4.018. Lauriston Building
Lauriston Place, EDINBURGH, EH3 9HA
tel: 00 (0)131 536 2041

On 6 April 2018 at 17:20:46, STORRAR Neill (neill.storrar@ed.ac.uk) wrote:

> Dear Professor Rees
>
> I am emailing for further advice about providing financial incentive to increase the response rate in a survey related to my research project [MVM-SEC 2017-10]
>
> As per correspondence about the baseline survey (copied below) I plan to repeat a prize draw voucher scheme.
>
> However, this time I wondered about also providing a voucher for the students' Final Year Committee (which raises money for their graduation ball) where the voucher's value would increase depending on response rate.

For example, £50 if there are 50 responses, £100 for 100 responses and £150 for 150 responses or more.

Does this seem reasonable or is there a risk that this causes unhelpful peer pressure to complete the survey?

As ever I would be extremely grateful for your thoughts

Best wishes

Neill Storrar

From: STORRAR Neill
Sent: 13 November 2017 14:10
To: REES Jonathan <Jonathan.Rees@ed.ac.uk>; MUIR Karen <Karen.Muir@ed.ac.uk>
Subject: RE: Advice about addendum to previous ethics committee submission.

Dear Jonathan

Thank you very much for your response – much appreciated. And apologies for the direct emai; an oversight on my part.

Best wishes

Neill

From: REES Jonathan
Sent: 13 November 2017 14:08
To: STORRAR Neill <neill.storrar@ed.ac.uk>; MUIR Karen <Karen.Muir@ed.ac.uk>
Subject: Re: Advice about addendum to previous ethics committee submission.

Neil, I am happy with this.

BTW, for future, please address all emails to karen.muir@ed.ac.uk as she collates and keeps track of any requests. I lose them.

Jonathan

Professor Jonathan Rees FMedSci
Grant Chair of Dermatology
Edinburgh Medical School
University of Edinburgh

See the new version of www.skincancer909.com

Learn dermatology!
www.reestheskin.me/teaching — learn dermatology
www.reestheskin.me/picgal/ — open image library of skin cancer
www.skincancer909.com — for an open access textbook of skin cancer

About me
www.reestheskin.me — about me, and some other stuff

www.reestheskinblog.me — my blog mainly about medicine and education
@reestheskin

Postal address:
Dermatology, Rm 4.018. Lauriston Building
Lauriston Place, EDINBURGH, EH3 9HA
tel: 00 (0)131 536 2041

On 13 November 2017 at 13:42:29, STORRAR Neill (neill.storrar@ed.ac.uk) wrote:
Dear Professor Rees

I'm emailing to ask about the process of adding an addendum to an ethics committee approval from earlier this year (MVM-SEC 2017/10). I have attached the original (approved) request, but we would be making an addendum to item 21.

In short, we have advertised a survey for Year 4 students, and in an effort to boost the return rate would like to add an inducement in the form of a small prize-draw for those who return the survey. I would like to offer e.g. one £20 voucher and four £10 vouchers for 5 randomly drawn student names.

Is this permissible? I understand if not.

The process would be that if students want to take part in the (optional) prize draw they follow a link to another 'survey' where they can submit their name and email for inclusion in the draw. This could not be directly linked to the response they gave in the main survey, though I appreciate this would still result in a list of (most) students who had participated.

I would be grateful for your advice about how to request this addendum (and how plausible it is)

Best wishes

Neill

Dr Neill Storrar
Clinical Fellow
Centre for Medical Education
University of Edinburgh

neill.storrar@ed.ac.uk

0131 242 9402

Appendix 6 – Original Learning Inventories

These are the original inventories used in the development of the peer learning attitudes survey. As detailed in Chapter 4 these were modified to reach the final 'Peer Learning Attitudes Survey' presented in Chapter 4. The original references for these are:

1) The Team Effectiveness Questionnaire

Parmelee, D.X., DeStephen, D., Borges, N.J., 2009. Medical students' attitudes about team-based learning in a pre-clinical curriculum. Med. Educ. Online 14, 1. https://doi.org/10.3885/meo.2009.Res00280

2) The Readiness for Interprofessional Learning Questionnaire

Parsell, G., Bligh, J., 1999. The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). Med. Educ. 95–100.

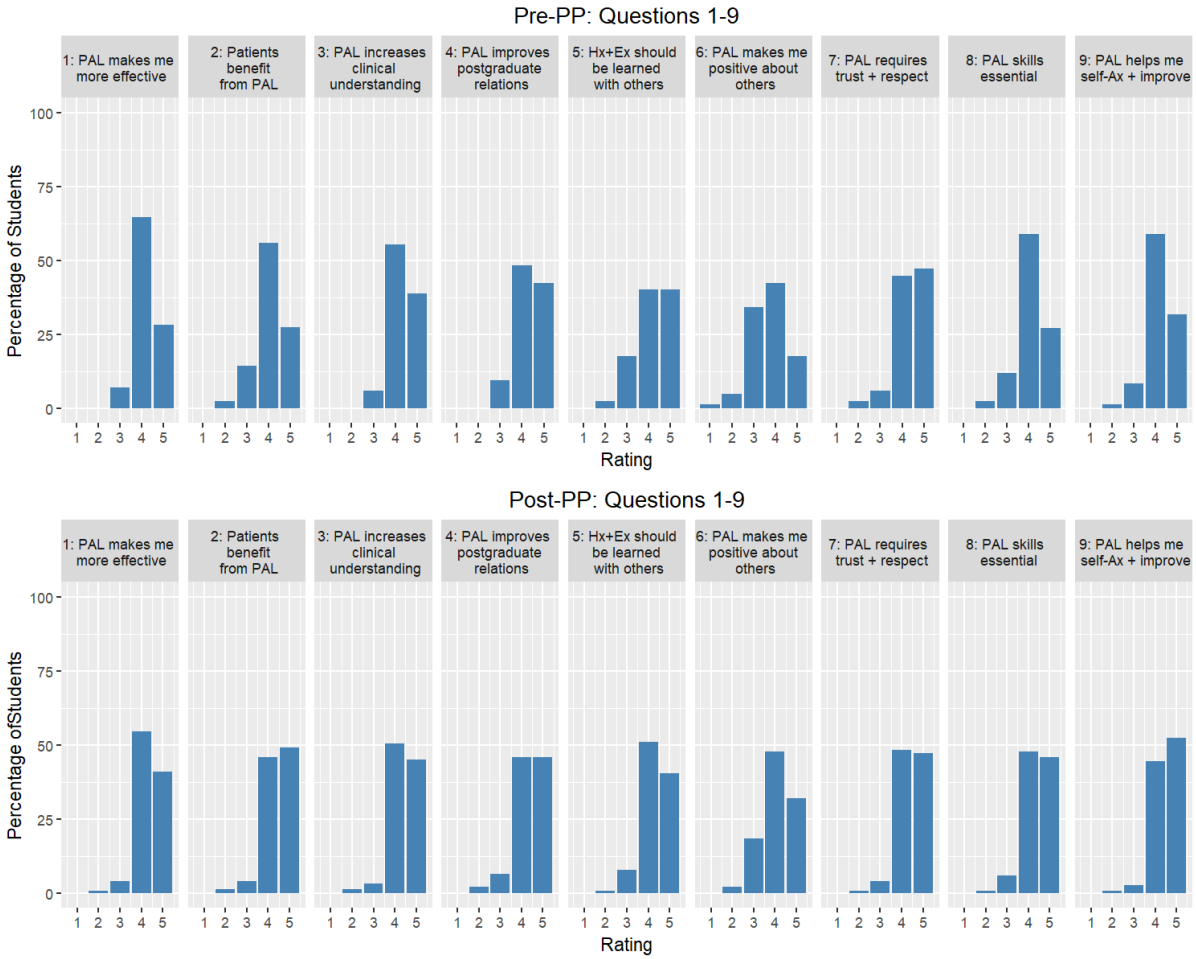
Parmelee Team Effectiveness (Parmelee *et al.* 2009)
Overall Satisfaction with Team Experience
I have found working as part of a team in my class to be a valuable experience
In most of the teams I have been on, the other team members have generally contributed as much as I have
In most of the teams I have been on, the team has worked well together
In most of the teams I have been on, I felt the other team members respected me
I have found teamwork to be a productive use of course time
Team Impact on Quality of Learning
I have found that teams help me learn course material more than if I just studied alone
I have learned more in courses where I have been a member of a team
I have found being part of a team improves my course grades
Satisfaction with Peer Evaluation
I have found that my peers have been fair in judging my contributions to a team
I have found that peer evaluation motivates me to work harder
I have generally liked the use of peer evaluation as part of my team experience
I have found that peer evaluation motivates me to work more collaboratively
Team Impact on Clinical Reasoning Ability
I have found that being on a team has helped me become better at problem solving
I have found that teams make good decisions
Being part of a team discussion has improved my ability to think through a problem
Professional Development
I have found that working with a team helps me develop skills in working with others
I have found that working with a team has helped me develop cooperative leadership skills
I have found that working with a team has helped me develop more respect for the opinions of others
I have found that working with a team has has enhanced my sense of who I am

Parsell Readiness for Interprofessional Learning (Parsell and Bligh 1999)
Team-work and Collaboration
Learning with other students will help me become a more effective member of a health care team
Patients would ultimately benefit if health care students worked together to solve patient problems
Shared learning with other health care students will increase my ability to understand clinical problems
Learning with health care students before qualification would improve relationships after qualification
Communication skills should be learned with other healthcare students
Shared learning will help me to think positively about other professionals
For small group learning to work, students need to trust and respect each other
Team-working skills are essential for all health care students to learn
Shared learning will help me to understand my own limitations
Professional Identity
I don't want to waste my time learning with other health care students
It is not necessary for undergraduate health care students to learn together
Clinical problem-solving skills can only be learned with students form my own department
Shared learning with other health care students will help me to communicate better with patients and other professionals
I would welcome the opportunity to work on small-group projects with other health care students
Shared learning will help to clarify the nature of patient problems
Shared learning before qualification will help me become a better team worker
Roles and responsibilities
The function of nurses and therapists is mainly to provide support for doctors
I'm not sure what my professional role will be
I have to acquire much more knowledge and skills than other health care students

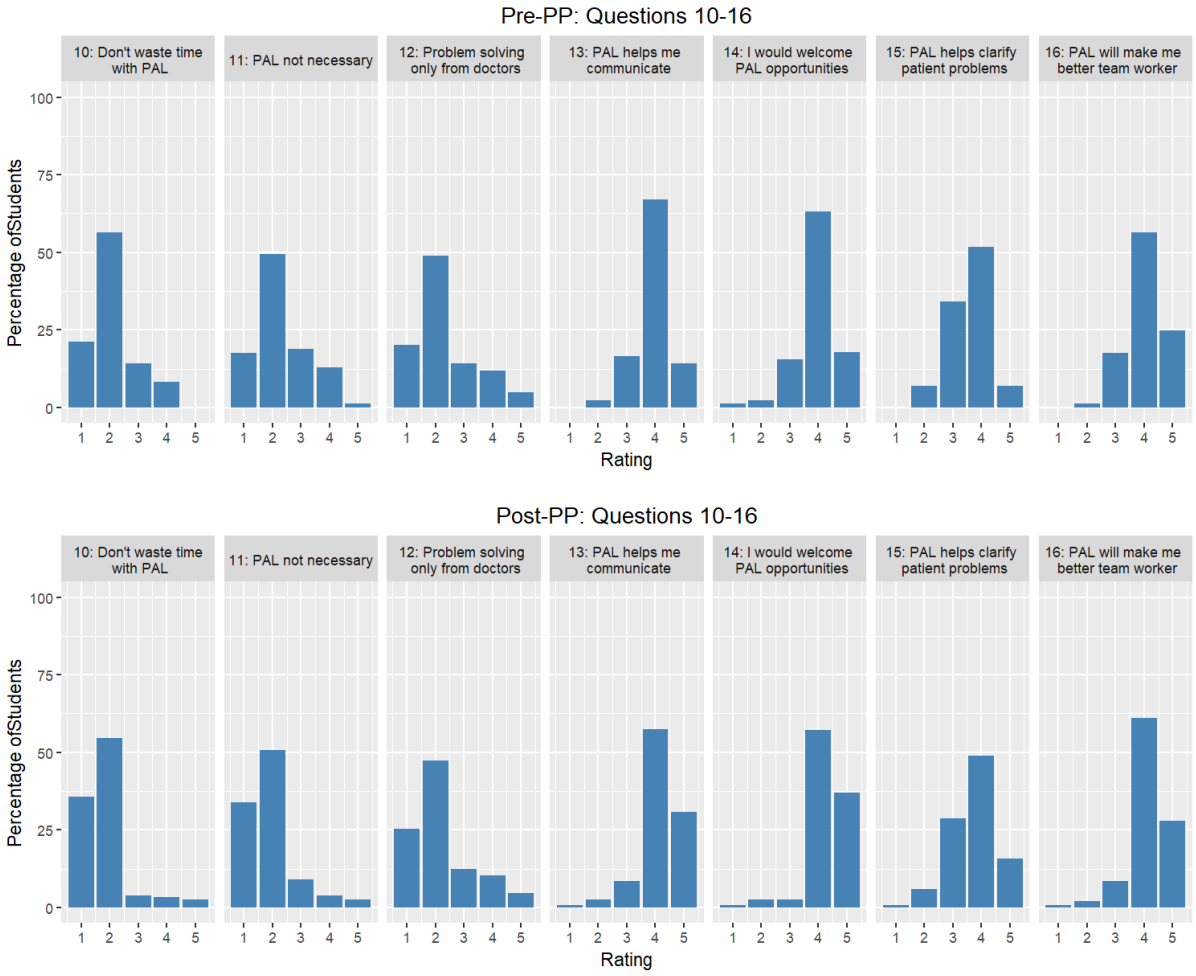
Appendix 7 – Peer Learning Attitudes Survey Responses

The Peer Learning Attitudes questionnaire questions can be found in Appendix 0. The responses from before and after the introduction of Peer Practice are shown here in graph form. 'Pre-PP' means the data came from the questionnaire completed before Peer Practice. 'Post-PP' means the data came from the questionnaire completed after Peer Practice. Students were asked to rate their agreement with each statement on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

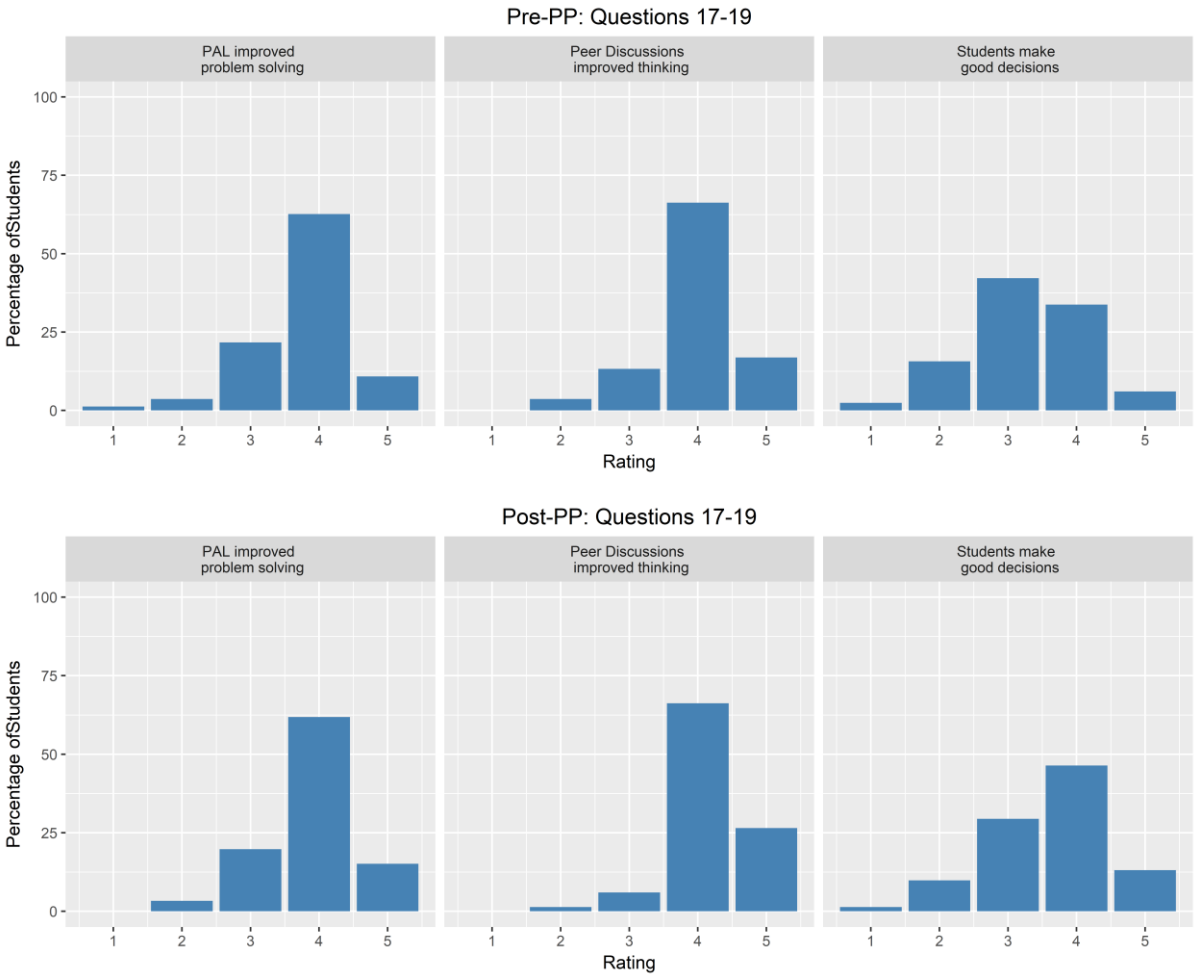
Questions 1 to 9



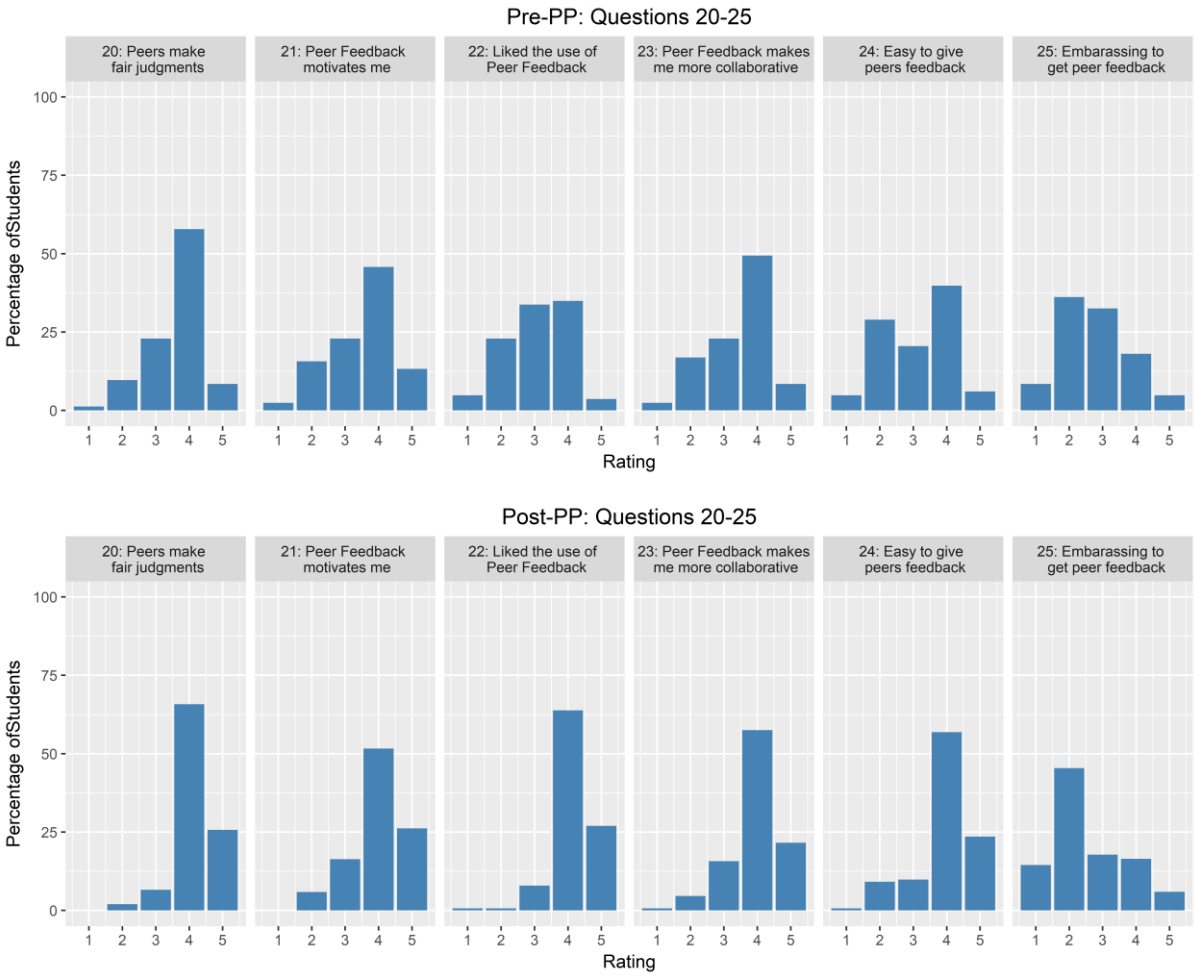
Questions 10-16



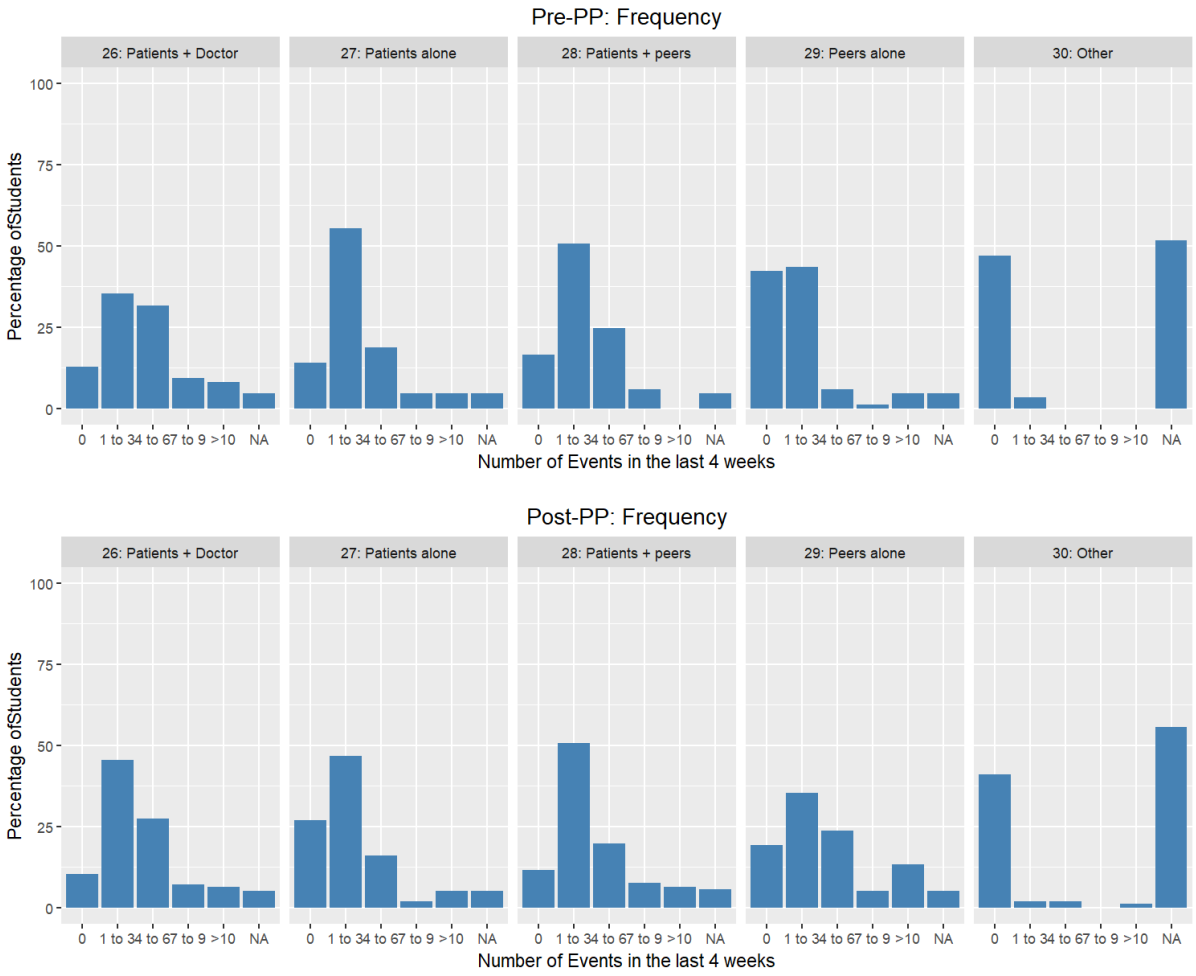
Questions 17-19



Questions 20-25



Frequency of performing clinical history and examination in various contexts before and after the introduction of peer learning with Peer Practice (PP)



Appendix 8 – Peer Practice Evaluation

This appendix shows Peer Practice Evaluation Questionnaire, followed by the students' responses summarised in graph form.

Peer Practice Evaluation Questionnaire

All questions were scored from 1 (strongly disagree) to 5 (strongly agree) unless otherwise stated.

Overall Views

1. Overall I found Peer Practice was an enjoyable way to learn history and examination
2. Peer Practice improved my ability to perform a competent history and examination
3. Peer Practice encouraged me to learn with my peers more often
4. Peer Practice helped me work with my peers more effectively
5. I found it easy to give my peers feedback by using Peer Practice
6. I got useful feedback from my peers using Peer Practice
7. Peer Practice improved the feeling of community amongst students.
8. Peer Practice should be expanded to include other modules or activities
9. Peer Practice should be required for all students
10. Peer Practice should continue in its current format

Common criteria questions

11. It was easy to find and use the Common Criteria on Learn)
12. It was clear to me what each item in the Criteria meant
13. The Common Criteria helped develop my history and examination skills
14. When Using the Common Criteria I prefer…

Paper Copy // PDF/online // the app (Pebble Pocket) // Other (specify)

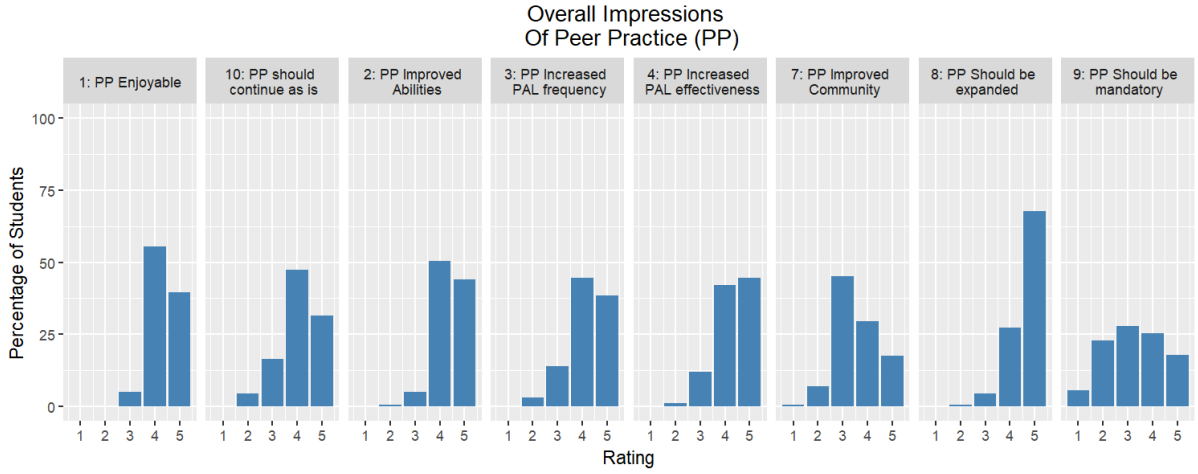
Pebble Pocket App

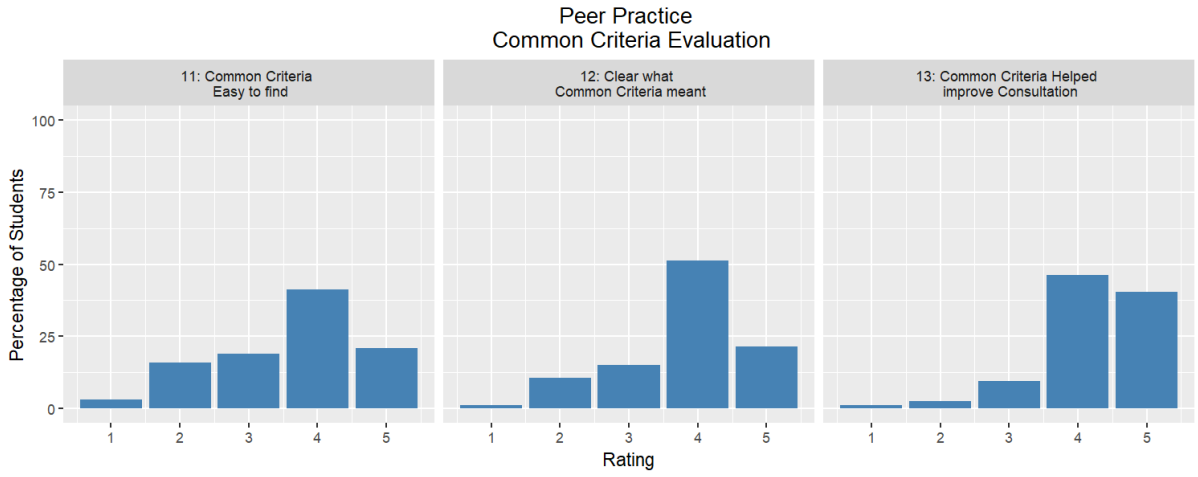
15. Have you downloaded the app? Yes // no
    a) If no why not? I didn't know about it // I couldn't make it work // I prefer not to use it // I have no suitable mobile device // Other (please specify)
16. I found the Pebble Pocket app easy to download and use
17. The app made it easier to practise history and examination skills with other students
18. The app made it more likely that I would practise these skills in a clinical setting (wards, clinics etc)
19. It was EASY to save records and send them to Pebble Pad (online)
20. It was USEFUL to save and organise records on Pebble Pad

Frequency of use Please select the number of times you have done Peer Practice using either the app or the Common Criteria in each of the following situations 0 // 1 to 5 // 6 to 10 // 11-15 // 16-20 // 20+ (if 20+ specify) 21. WITH other students 22. WITHOUT other students
Please add any other comments about any aspect of Peer Practice or the questions above (with question number as appropriate)

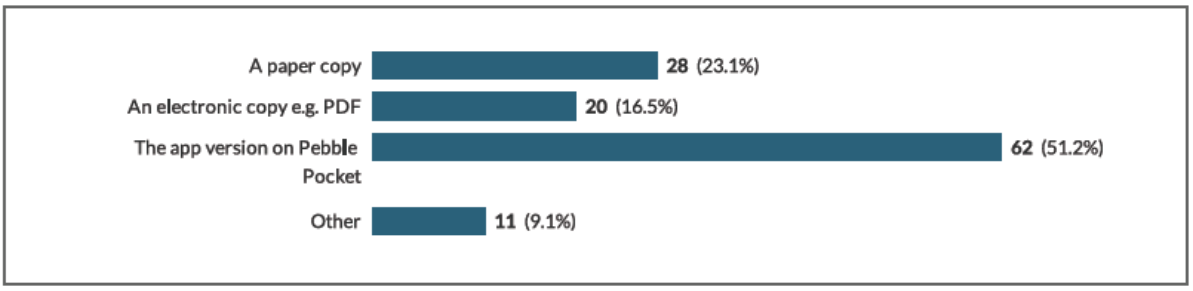
Responses to Peer Practice Evaluation Questionnaire

Students were asked to rate each statement on a scale of 1 to 5 where 1 was 'Strongly Disagree' and 5 was 'Strongly Agree'. The graphs were generated using R Studio v 1.1.453 with the exception of questions 14 and 15 which show the output from the Bristol Online Survey results.





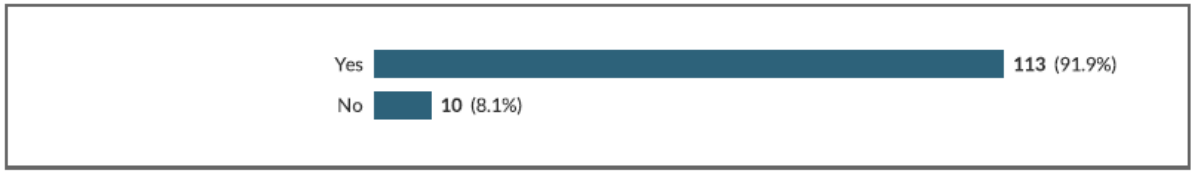
14) When using the Criteria I prefer...



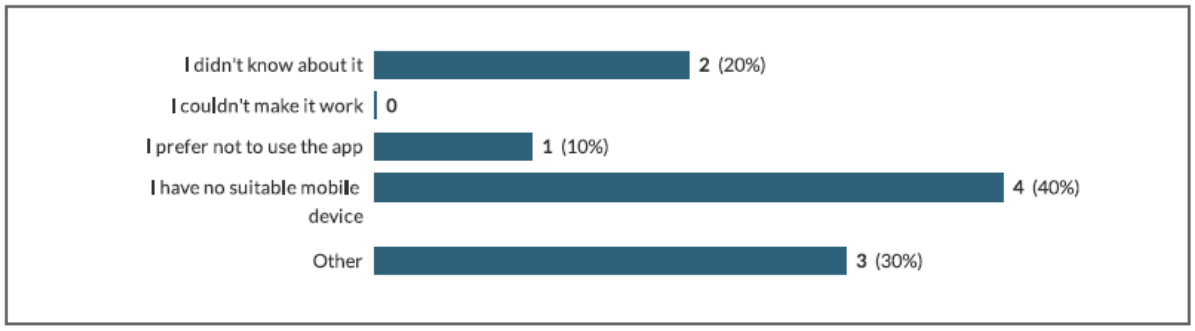
If you selected Other, please specify:

Showing 5 of 11 responses	
Both the PDF and the app are good	355774-355765-33787439
PDF AND THE APP	355774-355765-34895966
Paper and the App	355774-355765-34896140
paper AND PDF AND App	355774-355765-34896347
App AND paper	355774-355765-34896532

15) Have you downloaded the Pebble Pocket app and used the checklists there?

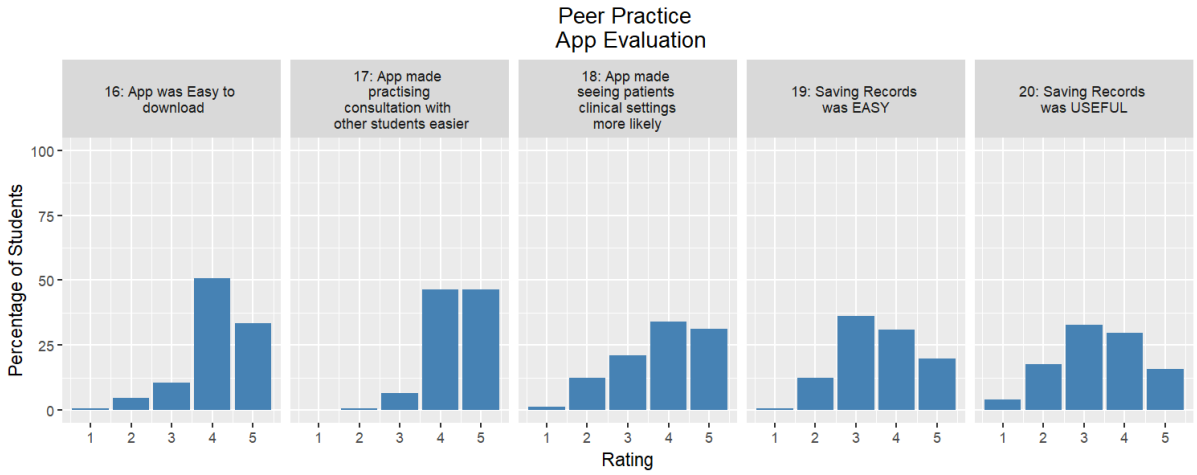


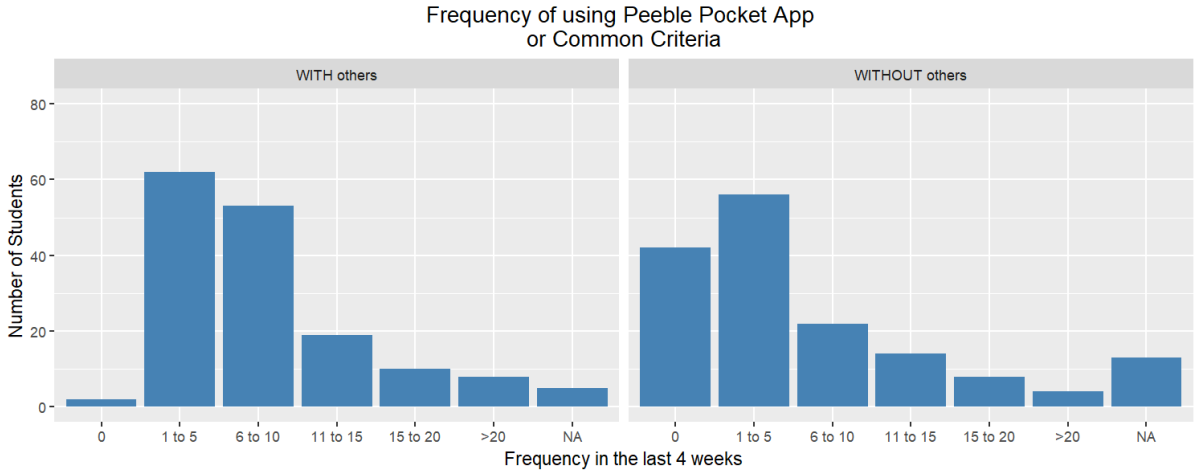
If no why not?



If you selected Other, please specify:

Showing all 3 responses	
Not enough memory on phone	355774-355765-33818075
Too big	355774-355765-34895737
My phone doesn't have enough storage	355774-355765-35030904


Peer Practice
App Evaluation
16: App was Easy to download
17: App made practising consultation with other students easier
18: App made seeing patients clinical settings more likely
19: Saving Records was EASY
20: Saving Records was USEFUL
Percentage of Students
100
75
50
25
0
1
2
3
4
5
Rating


Frequency of using Peeble Pocket App
or Common Criteria
WITH others
WITHOUT others
Number of Students
80
60
40
20
0
0
1 to 5
6 to 10
11 to 15
15 to 20
>20
NA
Frequency in the last 4 weeks

Appendix 9 – Glossary

Clinical Setting	The hospitals, general practice surgeries, outpatient clinics and other clinical workplaces where much of modern medical education takes place
Common Criteria	Part of Peer Practice, these were agreed criteria for a successful performance in clinical history taking or examination
Competency Based Medical Education	A movement in medical curriculum planning that defines the goals of education based on what graduates must be able to do to practise safely: competencies. Teaching design is then aimed at reaching and demonstrating these competencies.
Constructivism	A philosophical movement popular in medical education. It argues that all social phenomena are continually generated (constructed) by interactions and conventions between people. There are no independent truths and no testable reality. Researchers are encouraged account for the way they have co-created their findings with their participants.
Crossover Trials	A type of trial design where participants all experience the intervention but in different orders. By testing the relevant outcome with and without the intervention its impact can be measured
Grounded Theory	A method for producing a plausible theory that explains what is happening in a social scene. The theory is derived from data under study through processes like 'constant comparison' and 'theoretical sampling' (defined in Chapter 3). Various forms exist; Classic Grounded Theory (Glaserian) is the form used in this thesis
Internal Negotiation	The (grounded) theory of peer learning in the clinical setting produced in this thesis. Briefly put, it explains how students 'get ahead with their studies while getting along with their peers.' Students continually Negotiate (balance) educational pressures such as the *Expected Educational Gain, Social Risk* and *Social Reward* of taking part in peer learning. These terms are defined in Chapter 3. The outcome of this balancing determines behaviours.

Peer Learning	Where learners at a similar level teach one another and learn by doing so.
Peer Practice	A teaching project introduced into Edinburgh Medical School in 2017-2018. It aimed to promote peer learning of basic clinical consultation skills.
Practical Trials	A method for testing the 'real world' effects of a medical or educational intervention. It relies on pragmatic study design e.g. through crossover effects, has multiple outcomes of interest to stakeholders and has broad inclusion criteria.
Pragmatism	A philosophical movement referenced by many medical education researchers to allow flexibility in research decision making. It emphasises the way researchers should attend to the aims of their work, select appropriate methodology and examine how research processes influence the outcomes.
Theoretical Framework	The philosophical underpinnings of research, particularly emphasised in social research. Decisions about this influence what research paradigms and methods are appropriate

Appendix 10 – Thesis Outputs

The following is a list of the published papers, presentations and related outputs from the work in this thesis.

Published Paper (see Chapter 2)

Storrar, N., Hope, D., and Cameron, H., 2019. Student perspective on outcomes and process–Recommendations for implementing competency-based medical education. *Medical Teacher*, 41 (2), 161–166.

Conference Poster Presentations

Storrar, N., Hope, D., and Cameron, H., 2017. Can't we all just get along? Competition, collaboration and peer learning at medical school (Poster Presentation). *In*: *Association for Medical Education in Europe - Helsinki Finland, Abstract Book*.

Storrar, N., Hope, D., and Cameron, H., 2017. Students' priorities in medical training – are these values what we expect them to be? (Poster Presentation). *In*: *Abstracts of the Association for the Study of Medical Education Conference, Exeter, UK*.

Storrar, N., Hope, D., and Cameron, H., 2017. Can't we all just get along? Competition, collaboration and peer learning at medical school (Poster Presentation). *In*: *Abstracts of the Scottish Medical Education Conference, Edinburgh UK, May 2017*.

Other Invited Presentations

Storrar, N. Peer Practice: experience of custom workbooks and educational record keeping with Pebble Pocket, Presentation at Scottish PebblePad Users Group – University of Edinburgh, 31st Jauary 2018

Storrar, N. 'Can't We All Just Get Along?' Peer Feedback in Practical Clinical Skills. Presentation at Practical Approaches to Assessment in the Sciences, Centre for Science Education, University of Edinburgh, 22 February 2018

Funding

Principal's Teaching Award Scheme Small Project Grant (Awarded £1500) – March 2017 – for project 'Promoting a Promoting A Learning Community Through Peer Feedback - Navigating The Perspectives Of Staff And Students'.

Other Output

Guide for Educators using the Grounded Theory of Internal Negotiation

Storrar, N., Hope, D., and Cameron, H., 2019. How to Engage Students in Peer Feedback [online]. Available from: https://www.ed.ac.uk/institute-academic-development/learning-teaching/funding/funding/previous-projects/year/march-2017/peer-feedback [Accessed 12 May 2019].

A Blog Post on the use of Peer Feedback based on the PTAS Grant Award

Storrar, N., Cameron, H., and Hope, D., 2019. Promoting a learning community through peer feedback – Teaching Matters blog [online]. Available from: http://www.teaching-matters-blog.ed.ac.uk/promoting-peer-feedback-a-ptas-project/ [Accessed 12 May 2019].

A medical student project investigating Peer Practice

Student Selected Component 5a report by Jane Elford, Year 5 Medical Student, University of Edinburgh – submitted for assessment Spring 2019. A study of the practical barriers in the way Peer Practice was used in the clinical setting

Bibliography

Al-Kadri, H.M., Al-Kadi, M.T., Van Der Vleuten, C.P.M., and Vleuten, C.P.M. Van Der, 2013. Workplace-based assessment and students' approaches to learning: a qualitative inquiry. *Medical Teacher*, 35 (sup1), S31–S38.

Alavi, S.B. and McCormick, J., 2008. The roles of perceived task interdependence and group members' interdependence in the development of collective efficacy in university student group contexts. *British Journal of Educational Psychology*, 78 (3), 375–393.

Appelbaum, N.P., Dow, A., Mazmanian, P.E., Jundt, D.K., and Appelbaum, E.N., 2016. The effects of power, leadership and psychological safety on resident event reporting. *Medical Education*, 50 (3), 343–350.

Arnold, L., Shue, C.K., Kritt, B., Ginsburg, S., and Stern, D.T., 2005. Medical students' views on peer assessment of professionalism. *Journal of General Internal Medicine*, 20 (9), 819–824.

Basehore, P.M., Pomerantz, S.C., and Gentile, M., 2014. Reliability and benefits of medical student peers in rating complex clinical skills. *Medical Teacher*, 36 (5), 409–414.

Bennett, D., Kelly, M., and O'Flynn, S., 2012. Framework for feedback: the peer mini-clinical examination as a formative assessment tool. *Medical Education*, 46 (5), 512–512.

Bennett, D., O'Flynn, S., Kelly, M., O'Flynn, S., and Kelly, M., 2015. Peer assisted learning in the clinical setting: an activity systems analysis. *Advances in Health Sciences Education*, 20 (3), 595–610.

Bergeron, D., Champagne, J.-N., Qi, W., Dion, M., Theriault, J., Renaud, J.-S.J.-S., Thériault, J., and Renaud, J.-S.J.-S., 2018. Impact of a Student-Driven, Virtual Patient Application on Objective Structured Clinical Examination Performance: Observational Study. *Journal of Medical Internet Research*, 20 (2), e60.

Bernstein, R.J., 1991. *The New Constellation: The Ethical-Political Horizons of Modernity/Postmodernity.* Cambridge, UK: Polity Press.

Biesta, G., 2010. Pragmatism and the Philosophical Foundations of Mixed Methods Research. *In*: A. Tashakkori and C. Teddlie, eds. *Sage Handbook of Mixed Methods in Social & Behavioural Research*. Thousand Oaks: SAGE Publications, 95–118.

Biggs, J., 1996. Enhancing Teaching through Constructive Alignment. *Higher Education*, 32 (3), 347–364.

Billett, S., 2008. Learning throughout Working Life: A Relational Interdependence between Personal and Social Agency. *British Journal of Educational Studies*, 56 (1), 39–58.

Blake, A. and Carroll, B.T., 2016. Game theory and strategy in medical training. *Medical Education*, 50 (11), 1094–1106.

Bodkin, H., 2017. Medical students at University of Glasgow told to resit exam after 'collusion uncovered'. *The Telegraph*, 27 Mar.

Boell, S.K. and Cecez-kecmanovic, D., 2010. Literature Reviews and the Hermeneutic Circle. *Australian Academic and Research Libraries*, 41 (2), 1–17.

Boyd, V.A., Whitehead, C.R., Thille, P., Ginsburg, S., Brydges, R., and Kuper, A., 2018. Competency-based medical education: the discourse of infallibility. *Medical Education*, 52 (1), 45–57.

Branigan, T., Gibbons, D.D.-S., and Conway, L., 2017. Get Inside Their Smartphones and You Get Inside Their Heads! *In*: *Association for the Study of Medical Education Conference Proceedings*.

Brannick, M.T., Tugba Erol-Korkmaz, H., and Prewett, M., 2011. A systematic review of the reliability of objective structured clinical examination scores. *Medical Education*, 45, 1181–1189.

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3 (2), 77–101.

Breckenridge, J., 2009. Demystifying Theoretical Sampling in Grounded Theory Research. *Grounded Theory Review*, 8 (2), 113–126.

Breckenridge, J., 2010. Being Person Driven In A Service Driven Organisation: A Grounded Theory Of Revisioning Service Ideals And Client Realities. Queen Margaret University.

British Medical Association, 2018. Medical training pathway [online]. Available from: https://www.bma.org.uk/advice/career/studying-medicine/insiders-guide-to-medical-specialties/medical-training-pathway [Accessed 21 Mar 2018].

Bryant, A., 2003. A Constructive / ist Response to Glaser. *Forum Qualitative Sozialforschung*, 4 (1), 1–5.

Bryant, A., 2017a. The Grounded Theory Method and Pragmatism. *In*: *Grounded Theory and Grounded Theorizing*. 335–352.

Bryant, A., 2017b. *Grounded theory and grounded theorizing: Pragmatism in research practice*. Grounded Theory and Grounded Theorizing:

Pragmatism in Research Practice.

Bryman, A., Becker, S., and Sempik, J., 2008. Quality Criteria for Quantitative, Qualitative and Mixed Methods Research: A View from Social Policy. *International Journal of Social Research Methodology*, 11 (4), 261–276.

Buckley, S., Coleman, J., Davison, I., Khan, K.S., Zamora, J., Malick, S., Morley, D., Pollard, D., Ashcroft, T., Popovic, C., and Sayers, J., 2009. The educational effects of portfolios on undergraduate student learning: a Best Evidence Medical Education (BEME) systematic review. BEME Guide No. 11. *Medical Teacher*, 31 (4), 282–298.

Bunniss, S. and Kelly, D.R., 2010. Research paradigms in medical education research. *Medical Education*, 44 (4), 358–366.

Burgess, A., McGregor, D., and Mellis, C., 2014a. Medical students as peer tutors: A systematic review. *BMC Medical Education*, 14, 115.

Burgess, A.W., McGregor, D.M., and Mellis, C.M., 2014b. Applying established guidelines to team-based learning programs in medical schools: A systematic review. *Academic Medicine*, 89 (4), 678–688.

Calhoun, J.G., Haken, J.D. Ten, and Woolliscroft, J.O., 1990. Medical students' development of self- and peer-assessment skills: A longitudinal study. *Teaching and Learning in Medicine*, 2 (1), 25–29.

Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A.L., Sandercock, P., Spiegelhalter, D., and Tyrer, P., 2000. Framework for design and evaluation of complex interventions to improve health. *BMJ : British Medical Journal*, 321 (7262), 694–696.

Ten Cate, O. and Durning, S., 2007a. Peer teaching in medical education: twelve reasons to move from theory to practice. *Medical Teacher*, 29 (6), 591–599.

Ten Cate, O. and Durning, S., 2007b. Dimensions and psychology of peer teaching in medical education. *Medical Teacher*, 29 (6), 546–552.

Ten Cate, O.T.J., Kusurkar, R.A., and Williams, G.C., 2011. How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE Guide No. 59. *Medical Teacher*, 33 (12), 961–973.

Charmaz, K., 2000. Grounded Theory: Objectivist and Constructivist Methods. *In*: N.K. Denzin and Y.S. Lincoln, eds. *Handbook of Qualitative Research*. Thousand Oaks California: SAGE Publications, 509–535.

Charmaz, K., 2006. *Grounded Theory - A Practical Guide Through Qualitative Analysis*. London: SAGE Publications.

Chen, C.C., Chen, X.-P., and Meindl, J.R., 1998. How Can Cooperation Be Fostered? The Cultural Effects of Individualism-Collectivism. *The Academy of Management Review*, 23 (2), 285–304.

Chinnah, T.I., De Bere, S.R., and Collett, T., 2011. Students' views on the impact of peer physical examination and palpation as a pedagogic tool for teaching and learning living human anatomy. *Medical Teacher*, 33 (1), e27–e36.

Chou, C.L., Masters, D.E., Chang, A., Kruidering, M., and Hauer, K.E., 2013. Effects of longitudinal small-group learning on delivery and receipt of communication skills feedback. *Medical Education*, 47 (11), 1073–1079.

Chou, C.L., Teherani, A., Masters, D.E., Vener, M., Wamsley, M., and Poncelet, A., 2014. Workplace learning through peer groups in medical school clerkships. *Medical Education Online*, 19 (0), 25809.

Cohen, J., 1992. A Power Primer. *Psychological Bulletin*, 112 (1), 155–159.

Cook, D.A., 2012. If you teach them, they will learn: why medical education needs comparative effectiveness research. *Advances in Health Sciences Education*, 17 (3), 305–310.

Cook, D.A., 2014. How much evidence does it take? A cumulative meta-analysis of outcomes of simulation-based education. *Medical Education*, 48 (8), 750–760.

Cook, D.A. and West, C.P., 2013. Perspective: Reconsidering the Focus on "Outcomes Research" in Medical Education: A Cautionary Note. *Academic Medicine*, 88 (2), 162–167.

Corbin, J. and Strauss, A., 1990. Grounded Theory Research: Procedures, Canons and Evaluative Criteria. *Zeitschrift für Soziologie*, 19 (6), 418–427.

Craig, P., Dieppe, P., Macintyre, S., Health, P., Unit, S., Michie, S., Nazareth, I., and Petticrew, M., 2008. *Developing and evaluating complex interventions*. Medical Research Council.

Creswell, J.W., 2010. Mapping the Developing Landscape of Mixed Methods Research. *In*: A. Tashakkori and C. Teddlie, eds. *Sage Handbook of Mixed Methods in Social & Behavioural Research*. Thousand Oaks: SAGE Publications, 45–68.

Creswell, J.W., Fetters, M.D., and Ivankova, N. V., 2004. Designing A Mixed Methods Study In Primary Care. *The Annals of Family Medicine*, 2 (1), 7–12.

Cushing, A., Abbott, S., Lothian, D., Hall, A., and Westwood, O.M.R., 2011. Peer feedback as an aid to learning - What do we want? Feedback.

When do we want it? Now! *Medical Teacher*, 33 (2), e105–e112.

Cushing, A.M. and Westwood, O.M.R., 2010. Using peer feedback in a formative objective structured clinical examination. *Medical Education*, 44 (11), 1144–1145.

Denny, P., Hamer, J., Luxton-Reilly, A., and Purchase, H., 2008. PeerWise. *Proceedings of the 8th International Conference on Computing Education Research*, 109–112.

Diez, D.M., Barr, C.D., and Cetinkaya-Rundel, M., 2015. *OpenIntro Statistics*. 3rd ed. Web Publication: openintro.org.

Dimond, R., Bullock, A., Lovatt, J., and Stacey, M., 2016. Mobile learning devices in the workplace: 'As much a part of the junior doctors' kit as a stethoscope'? *BMC Medical Education*, 16 (1).

Donia, M.B.L., O'Neill, T.A., and Brutus, S., 2018. The longitudinal effects of peer feedback in the development and transfer of student teamwork skills. *Learning and Individual Differences*, 61, 87–98.

Dovidio, J.F., Gaertner, S.L., and Esses, V.M., 2008. Cooperation, common identity, and intergroup contact. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction.* Oxford, UK: Blackwell Publishing Ltd, 143–159.

Dowell, J., Cleland, J., Fitzpatrick, S., McManus, C., Nicholson, S., Oppé, T., Petty-Saphon, K., King, O.S., Smith, D., Thornton, S., and White, K., 2018. The UK medical education database (UKMED) what is it? Why and how might you use it? *BMC Medical Education*, 18 (1), 6.

Dunn, O.J., 1961. Multiple Comparisons Among Means. *Journal of the American Statistical Association*, 56 (293), 52–64.

Dunne, C., 2011. The place of the literature review in grounded theory research. *International Journal of Social Research Methodology*, 14 (2), 111–124.

Duvivier, R., Stalmeijer, R., Van Dalen, J., Van Der Vleuten, C., and Scherpbier, A., 2014. Influence of the workplace on learning physical examination skills. *BMC medical education*, 14, 61.

Duvivier, R.J., van Geel, K., van Dalen, J., Scherpbier, A.J.J.A., and van der Vleuten, C.P.M., 2012. Learning physical examination skills outside timetabled training sessions: what happens and why? *Advances in Health Sciences Education*, 17 (3), 339–355.

Edgerton, R.B., 1971. *The cloak of competence : stigma in the lives of the mentally retarded*. Berkeley: University of California Press.

Edmondson, A., 1999. Psychological Safety and Learning Behavior in Work Teams. *Source: Administrative Science Quarterly*, 44 (2), 350–383.

Eva, K.W., Armson, H., Holmboe, E., Lockyer, J., Loney, E., Mann, K., Sargeant, J., Eva, K.W., Armson, H., Lockyer, Á.J., Holmboe, E., Loney, E., Mann, Á.K., and Sargeant, Á.J., 2012. Factors influencing responsiveness to feedback: on the interplay between fear, confidence, and reasoning processes. *Adv in Health Sci Educ*, 17, 15–26.

Evans, G.L., 2013. A Novice Researcher's First Walk Through the Maze of Grounded Theory: Rationalization for Classical Grounded Theory. *The Grounded Theory Review*, (1), 37–55.

Falchikov, N. and Goldfinch, J., 2000. Student Peer Assessment in Higher Education: A Meta-Analysis Comparing Peer and Teacher Marks. *Review of Educational Research*, 70 (3), 287–322.

Fantuzzo, J., Riggio, R., Connelly, S., and Dimeff, L., 1989. Effects of Reciprocal Peer Tutoring on Academic-Achievement and Psychological Adjustment - a Component Analysis. *Journal of Educational Psychology*, 81 (2), 173–177.

Faul, F., Erdfelder, E., Lang, A.-G., and Buchner, A., 2007. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39 (2), 175–191.

Federation of State Medical Boards of the United States and the National Board of Medical Examiners, 2014. USMLE Physician Tasks/Competencies.

Federation of State Medical Boards of the United States and the National Board of Medical Examiners, 2018. United States Medical Licensing Examination Step 2 Clinical Skills (CS): Content Description and General Information.

Finucane, P., Nicholas, T., and Prideaux, D., 2001. The new medical curriculum at Flinders University, South Australia: From concept to reality. *Medical Teacher*, 23 (1), 76–79.

Flin, R., O'Connor, P., and Crichton, M., 2008. *Safety at the sharp end: A guide to non-technical skills*. Safety at The Sharp End: A Guide to Non-Technical Skills. Ashgate.

Frank, J., Mungroo, R., Ahmad, Y., Wang, M., De Rossi, S., and Horsley, T., 2010. Toward a definition of competency-based education in medicine: a systematic review of published definitions. *Medical Teacher*, 32 (8), 631–637.

Frank, J., Snell, L., and Sherbino J, E., 2015. CanMEDs 2015 Physician Competency Framework. *CanMEDS 2015 Physician Competency*

Framework. Ottawa: Royal College of Physicians and Surgeons of Canada.

Gallegos, P.J. and Peeters, J.M., 2011. A measure of teamwork perceptions for team-based learning. *Currents in Pharmacy Teaching and Learning*, 3 (1), 30–35.

General Medical Council, 2009. *Clinical placements for medical students*. Manchester: General Medical Council.

General Medical Council, 2015. *Outcomes for Graduates*. Manchester: General Medical Council.

General Medical Council, 2016. *Promoting excellence: standards for medical education and training*. Manchester: General Medical Council.

General Medical Council, 2017. The Foundation Programme [online]. Available from: https://www.gmc-uk.org/education/postgraduate/foundation_programme.asp [Accessed 10 Nov 2017].

General Medical Council, 2018. A guide to the PLAB test [online]. *General Medical Council*. Available from: https://www.gmc-uk.org/registration-and-licensing/join-the-register/plab/a-guide-to-the-plab-test [Accessed 11 May 2019].

Van Gennip, N.A.E., Segers, M.S.R., and Tillema, H.H., 2009. Peer assessment for learning from a social perspective: The influence of interpersonal variables and structural features. *Educational Research Review*, 4, 41–54.

Glaser, B.G., 1978. *Theoretical sensitivity: Advances in the methodology of grounded theory.* Mill Valley California: Sociology Press.

Glaser, B.G., 1992. *Emergence vs forcing : basics of grounded theory analysis*. Mill Valley California: Sociology Press.

Glaser, B.G., 1998. *Doing Grounded Theory: Issues and Discussions*. 1st ed. Mill Valley California: Sociology Press.

Glaser, B.G., 2002a. Constructivist Grounded Theory? *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 3 (3).

Glaser, B.G., 2002b. Conceptualization: On theory and theorizing using grounded theory. *International Journal of Qualitative Methods*, 1, 23–38.

Glaser, B.G., 2005. *The Grounded Theory Perspective III: Theoretical Coding*. 1st ed. Mill Valley California: Sociology Press.

Glaser, B.G., 2008. *Quantitative Grounded Theory*. Mill Valley California:

Sociology Press.

Glaser, B.G. and Strauss, A.L., 1965. *Awareness of dying*.

Glaser, B.G. and Strauss, A.L., 1967. *The discovery of grounded theory: strategies for qualitative research*. Chicago : New York: Aldine PubCo.

Glynn, L.G., MacFarlane, A., Kelly, M., Cantillon, P., Murphy, A.W., and Murphy -andrewmurphy, A.W., 2006. BMC Medical Education Helping each other to learn – a process evaluation of peer assisted learning. *BMC Medical Education*, 6.

Greene, M., 2014. On the Inside Looking In: Methodological Insights and Challenges in Conducting Qualitative Insider Research. *Qualitative Report*, 19 (29), 1.

Guba, E.G. and Lincoln, Y.S., 1994. Competing Paradigms in Qualitative Research. *In*: N. Denzin and Y. Lincoln, eds. *Handbook of Qualitative Research*. Thousand Oaks, Calif. ; London: Sage, 105–117.

Gully, S.M., Incalcaterra, K.A., Joshi, A., and Beaubien, J.M., 2002. A meta-analysis of team-efficacy, potency, and performance: Interdependence and level of analysis as moderators of observed relationships. *Journal of Applied Psychology*, 87 (5), 819–832.

Hagen, E.H. and Hammerstein, P., 2006. Game theory and human evolution: A critique of some recent interpretations of experimental games. *Theoretical Population Biology*, 69, 339–348.

Haig, A. and Dozier, M., 2003. BEME Guide No. 3: Systematic searching for evidence in medical education - Part 2: Constructing searches. *Medical Teacher*.

Haji, F., Morin, M.P., and Parker, K., 2013. Rethinking programme evaluation in health professions education: Beyond ‘did it work?’ *Medical Education*, 47 (4), 342–351.

Hanley, J., Hartwig, J., Orbell, J., and Morikawa, T., 2008. Evolutionary Psychology and a More Satisfactory Model of Human Agency. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction*. Oxford, UK: Blackwell Publishing Ltd, 35–52.

Harden, R., Grant, J., Buckly, G., and Hart, I., 1999. BEME Guide No. 1: Best Evidence Medical Education. *Medical Teacher*, 21 (6), 553–562.

Harden, R.M. and Gleeson, F.A., 1979. Assessment of clinical competence using an objective structured clinical examination (OSCE). *Medical Education*, 13 (1), 39–54.

Harrison, C.J., Könings, K.D., Dannefer, E.F., Schuwirth, L.W.T., Wass, V., and van der Vleuten, C.P.M., 2016. Factors influencing students' receptivity to formative feedback emerging from different assessment cultures. *Perspectives on Medical Education*, 5 (5), 276–284.

Hastings, A., McKinley, R.K., and Fraser, R.C., 2006. Strengths and weaknesses in the consultation skills of senior medical students: identification, enhancement and curricular change. *Medical education*, 40 (5), 437–43.

Havyer, R.D., Nelson, D.R., Wingo, M.T., Comfere, N.I., Halvorsen, A.J., McDonald, F.S., and Reed, D.A., 2015. Addressing the Interprofessional Collaboration Competencies of the Association of American Medical Colleges. *Academic Medicine*, 91 (6), 865–888.

Heckmann, J.G., Dütsch, M., Rauch, C., Lang, C., Weih, M., and Schwab, S., 2008. Effects of peer-assisted training during the neurology clerkship: A randomized controlled study. *European Journal of Neurology*, 15 (12), 1365–1370.

Hernandez, C.A., 2009. Theoretical Coding in Grounded Theory Methodology. *The Grounded Theory Review*, 8 (3), 51–66.

Herrmann-Werner, A., Gramer, R., Erschens, R., Nikendei, C., Wosnik, A., Griewatz, J., Zipfel, S., Junne, F., and Herrmann-Werner, A., 2017. Peer-assisted learning (PAL) in undergraduate medical education: An overview. *Zeitschrift fur Evidenz Fortbildung und Qualitat Gesundheitswesen (ZEFQ)*, 121, 74–81.

Hmelo - Silver, C.E., 2006. Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review*, 16 (3), 235–266.

Hofstede, G.H., 1980. *Culture's consequences : international differences in work-related values*. Beverly Hills, Calif.: Sage Publications.

Hofstede, G.H., 2001. *Culture's consequences : comparing values, behaviors, institutions and organizations across nations*. Second edi. Thousand Oaks, Calif. ; London: Sage.

Holderried, F., Heine, D., Wagner, R., Mahling, M., Fenik, Y., Herrmann-Werner, A., Riessen, R., Weyrich, P., Zipfel, S., Celebi, N., and Baradaran, H.R., 2014. Problem-Based Training Improves Recognition of Patient Hazards by Advanced Medical Students during Chart Review: A Randomized Controlled Crossover Study. *PLoS ONE*, 9 (2), e89198.

Hope, D. and Dewar, A., 2015. Conducting quantitative educational research: a short guide for clinical teachers. *Clinical Teacher*, 12 (5), 299–304.

House, J., Choe, C., Wourman, H., Berg, K., Fischer, J., and Santen, S., 2017. Efficient and Effective Use of Peer Teaching for Medical Student

Simulation. *Western Journal of Emergency Medicine*, 18 (1), 137–141.

Howe, K., 1992. Getting over the qualitative-quantitative debate. *American Journal of Education*, 100 (129), 236–256.

Hulsman, R.L. and van der Vloodt, J., 2015. Self-evaluation and peer-feedback of medical students' communication skills using a web-based video annotation system. Exploring content and specificity. *Patient Education and Counseling*, 98 (3), 356–363.

Hunukumbure, A.D., Smith, S.F., and Das, S., 2017. Holistic feedback approach with video and peer discussion under teacher supervision. *BMC Medical Education*, 17 (1).

Illing, J., 2014. Thinking About Research: Theoretical Perspectives, Ethics and Scholarship - Ethics section. *In*: T. Swanwick, ed. *Understanding Medical Education: Evidence, Theory and Practice*. Chichester, UK: John Wiley & Sons, Ltd, 342–345.

Ioannidis, J.P.A., 2005. Why most published research findings are false. *PLoS Medicine*, 2 (8), 696–701.

Jacobs, J.L., Samarasekera, D.D., Shen, L., Rajendran, K., and Chuan Hooi, S., 2014. Encouraging an environment to nurture lifelong learning: An Asian experience. *Medical Teacher*, 36 (2), 164–168.

Jamieson, S., 2004. Likert scales: how to (ab)use them. *Medical Education*, 38 (12), 1217–1218.

Johnson, D.W. and Johnson, R.T., 2009. An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning. *Educational Researcher*, 38 (5), 365–379.

Johnson, P. and Duberley, J., 2011. Pragmatism and Critical Realism - Transcending Descartes' Either/Or? *In*: P. Johnson and J. Duberley, eds. *Understanding Management Research*. London: SAGE Publications, 149–176.

Johnson, R.B. and Onwuegbuzie, A.J., 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher*, 33 (7), 14–26.

Johnston, J.M., Schooling, C.M., and Leung, G.M., 2009. A randomised-controlled trial of two educational modes for undergraduate evidence-based medicine learning in Asia. *BMC medical education*, 9, 63.

Jones, P. and Rai, B., 2015. The status of bedside teaching in the United Kingdom: the student perspective. *Advances in Medical Education and Practice*, 6, 421.

Kahneman, D., 2011. *Thinking, fast and slow*. London: Penguin.

Kirkpatrick, D.L. and Kirkpatrick, J.D., 2009. *Evaluating Training Programs*. Berrett-Koehler.

Knobe, M., Münker, R., Sellei, R.M., Holschen, M., Mooij, S.C., Schmidt-Rohlfing, B., Niethard, F.-U., and Pape, H.-C., 2010. Peer teaching: a randomised controlled trial using student-teachers to teach musculoskeletal ultrasound. *Medical Education*, 44 (2), 148–155.

Kovach, R.A., Resch, D.S., and Verhulst, S.J., 2009. Peer Assessment of Professionalism: A Five-Year Experience in Medical Clerkship. *Journal of General Internal Medicine*, 24 (6), 742–746.

Krogh, C.L., Ringsted, C., Kromann, C.B., Rasmussen, M.B., Todsen, T., Jørgensen, R.L., Jacobsen, R.B., Dahl, J.B., and Konge, L., 2014. Effect of Engaging Trainees by Assessing Peer Performance: A Randomised Controlled Trial Using Simulated Patient Scenarios. *BioMed Research International*, 2014, 1–7.

Kusurkar, R.A., Ten Cate, T.J., Asperen, M. van, and Croiset, G., 2011. Motivation as an independent and a dependent variable in medical education: A review of the literature. *Medical Teacher*, 33 (5), e242–e262.

Kwok, J., Liao, W., and Baxter, S., 2017. Evaluation of an online peer fundus photograph matching program in teaching direct ophthalmoscopy to medical students. *Canadian Journal of Ophthalmology / Journal Canadien d'Ophtalmologie*, 52 (5), 441–446.

Laidlaw, A.H., 2009. Social anxiety in medical students: Implications for communication skills teaching. *Medical Teacher*, 31 (7), 649–654.

Van Lange, P.A.M., 2008. Logical and Paradoxical Effects: Understanding Cooperation in Terms of Prosocial and Proself Orientations. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction*. Oxford, UK: Blackwell Publishing Ltd, 17–34.

Lawton, B. and MacDougall, C., 2004. Developing clinical skills: a simple and practical tool. *Medical Education*, 38 (11), 1198–1199.

Lempp, H. and Seale, C., 2004. The hidden curriculum in undergraduate medical education: qualitative study of medical students' perceptions of teaching. *BMJ*, 329 (7469), 770–773.

Lingard, L., 2007. Qualitative research in the RIME community: critical reflections and future directions. *Academic medicine : journal of the Association of American Medical Colleges*, 82 (10 Suppl), S129–S130.

Liu, N.-F. and Carless, D., 2006. Peer feedback: the learning element of peer assessment. *Teaching in Higher Education*, 11 (3), 279–290.

Locke, K., 2015. Pragmatic Reflections on a Conversation About Grounded Theory in Management and Organization Studies. *Organizational Research Methods*, 18 (4), 612–619.

Lockspeiser, T.M., O'Sullivan, P., Teherani, A., and Muller, J., 2008. Understanding the experience of being taught by peers: The value of social and cognitive congruence. *Advances in Health Sciences Education*, 13 (3), 361–372.

Lomis, K.D., Russell, R.G., Davidson, M.A., Fleming, A.E., Pettepher, C.C., Cutrer, W.B., Fleming, G.M., and Miller, B.M., 2017. Competency milestones for medical students: Design, implementation, and analysis at one medical school. *Medical Teacher*, 39 (5), 1–11.

Lovell, B., 2015. `We are a tight community': social groups and social identity in medical undergraduates. *MEDICAL EDUCATION*, 49 (10), 1016–1027.

Lurie, S.J., Lambert, D.R., Nofziger, A.C., Epstein, R.M., and Grady-Weliky, T.A., 2007. Relationship between peer assessment during medical school, dean's letter rankings, and ratings by internship directors. *Journal of General Internal Medicine*, 22 (1), 13–16.

Luscombe, C. and Montgomery, J., 2016. Exploring medical student learning in the large group teaching environment: examining current practice to inform curricular development. *BMC Medical Education*, 16, 184.

Madigosky, W.S., Headrick, L.A., Nelson, K., Cox, K.R., and Anderson, T., 2006. Changing and Sustaining Medical Students?? Knowledge, Skills, and Attitudes about Patient Safety and Medical Fallibility. *Academic Medicine*, 81 (1), 94–101.

Marcus, J. and Le, H., 2013. Interactive effects of levels of individualism-collectivism on cooperation: A meta-analysis. *Journal of Organizational Behaviour*, 34, 818–834.

Martens, M.J.C., Duvivier, R.J., Van Dalen, J., Verwijnen, G.M., Scherpbier, A.J.J.A., and Van Der Vleuten, C.P.M., 2009. Student views on the effective teaching of physical examination skills: a qualitative study. *Medical Education*, 43 (2), 184–191.

Martineau, B., Mamede, S.S., St-Onge, C., Rikers, R.M.J.P., and Schmidt, H.G., 2013. To observe or not to observe peers when learning physical examination skills; that is the question. *BMC MEDICAL EDUCATION*, 13, 55.

Maslow, A.H., 1987. *Motivation and Personality*. 3rd ed. London: Harper &

Row.

Masters, K., Ellaway, R.H., Topps, D., Archibald, D., and Hogue, R.J., 2016. Mobile technologies in medical education: AMEE Guide No. 105. *Medical Teacher*, 38 (6), 537–549.

Mauthner, N.S. and Doucet, A., 2003. Reflexive Accounts and Accounts of Reflexivity in Qualitative Data Analysis. *Sociology*, 37 (3), 413–431.

McFadyen, A.K., Webster, V., Strachan, K., Figgins, E., Brown, H., and McKechnie, J., 2005. The Readiness for Interprofessional Learning Scale: a possible more stable sub-scale model for the original version of RIPLS. *Journal of interprofessional care*, 19 (6), 595–603.

McFadyen, A.K., Webster, V.S., Maclaren, W.M., and O'neill, M.A., 2010. Interprofessional attitudes and perceptions: Results from a longitudinal controlled trial of pre-registration health and social care students in Scotland. *Journal of Interprofessional Care*, 24 (5), 549–564.

McGaghie, W.C., Issenberg, S.B., Cohen, E.R., Barsuk, J.H., and Wayne, D.B., 2011. Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. *Academic Medicine*, 86 (6), 706–711.

McGaghie, W.C., Issenberg, S.B., Petrusa, E.R., and Scalese, R.J., 2010. A critical review of simulation-based medical education research: 2003-2009. *Medical Education*.

McGill, R., Tukey, J.W., and Larsen, W.A., 1978. Variations of Box Plots. *The American Statistician*, 32 (1), 12.

McMorran, C., Ragupathi, K., and Luo, S., 2017. Assessment and learning without grades? Motivations and concerns with implementing gradeless learning in higher education. *Assessment and Evaluation in Higher Education*, 42 (3), 361–377.

McNeill, K.G., Kerr, A., Mavor, K.I., Mcneill, K.G., Kerr, A., Mavor, Á.K.I., and Mavor, K.I., 2014. Identity and norms: the role of group membership in medical student wellbeing. *Perspect Med Educ*, 3, 101–112.

Monrouxe, L. V., Grundy, L., Mann, M., John, Z., Panagoulas, E., Bullock, A., and Mattick, K., 2017. How prepared are UK medical graduates for practice? A rapid review of the literature 2009-2014. *BMJ Open*, 7 (1), e013656.

Montgomery, K., 2006. The Misdescription of Medicine. Oxford ; New York: Oxford University Press, 29–41.

Morgan, D.L., 2014. Pragmatism as a Paradigm for Social Research.

Qualitative Inquiry, 20 (8), 1045–1053.

Nardon, L., Steers, R., Bhagat, R., and Steers, R., 2008. Chapter 1 The culture theory jungle: divergence and convergence in models of national culture. *In*: R.S. Bhagat, ed. *Cambridge Handbook of Culture, Organizations and Work*. Cambridge, UK: Cambridge University Press, 3–22.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979. Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research, Report Of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. *Federal Register*, 44 (76), 23191–23197.

Ng, S., Lingard, L., and Kennedy, T.J., 2013. Qualitative Research in Medical Education: Methodologies and Methods. *In*: T. Swanwick, ed. John Wiley & Sons, Ltd, 371–384.

Nikendei, C., Ganschow, P., Groener, J.B., Huwendiek, S., Kochel, A., Kohl-Hackert, N., Pjontek, R., Rodrian, J., Scheibe, F., Stadler, A.-K., Steiner, T., Stiepak, J., Tabatabai, J., Utz, A., and Kadmon, M., 2016. 'Heidelberg standard examination' and 'Heidelberg standard procedures' - Development of faculty-wide standards for physical examination techniques and clinical procedures in undergraduate medical education. *GMS Journal for Medical Education*, 33 (4), Doc54.

Norman, G., 2010. Likert scales, levels of measurement and the 'laws' of statistics. *Advances in Health Sciences Education*, 15, 625–632.

Norman, G., 2014a. Data dredging, salami-slicing, and other successful strategies to ensure rejection: twelve tips on how to not get your paper published. *Advances in Health Sciences Education*, 19 (1), 1–5.

Norman, G., 2014b. Data dredging, salami-slicing, and other successful strategies to ensure rejection: twelve tips on how to not get your paper published. *Advances in Health Sciences Education*, 19 (1), 1–5.

Norman, G. and Eva, K.W., 2013. Quantitative Research Methods in Medical Education. *In*: T. Swanwick, ed. *Understanding Medical Education*. John Wiley & Sons, Ltd, 349–369.

O'Cathain, A., 2010. Assessing the Quality of Mixed Methods Research: Toward a Comprehensive Framework. *In*: A. Tashakkori and C. Teddlie, eds. *Sage Handbook of Mixed Methods in Social & Behavioural Research*. Thousand Oaks: Sage, 531–556.

O'Reilly, M. and Parker, N., 2013. 'Unsatisfactory Saturation': a critical exploration of the notion of saturated sample sizes in qualitative

research. *Qualitative Research*, 13 (2), 190–197.

Olaussen, A., Reddy, P., Irvine, S., and Williams, B., 2016. Peer-assisted learning: time for nomenclature clarification. *Medical Education Online*, 21, 30974.

Orsmond, P., Merry, S., and Reiling, K., 2000. The Use of Student Derived Marking Criteria in Peer and Self-assessment. *Assessment & Evaluation in Higher Education*, 25 (1), 23–38.

Papadakis, M.A., Teherani, A., Banach, M.A., Knettler, T.R., Rattner, S.L., Stern, D.T., Veloski, J.J., and Hodgson, C.S., 2005. Disciplinary Action by Medical Boards and Prior Behavior in Medical School. *New England Journal of Medicine*, 353 (25), 2673–2682.

Parmelee, D., Michaelsen, L.K., Cook, S., and Hudes, P.D., 2012. Team-based learning: A practical guide: AMEE Guide No. 65. *Medical Teacher*, 34 (5), e275–e287.

Parmelee, D.X., DeStephen, D., and Borges, N.J., 2009. Medical students' attitudes about team-based learning in a pre-clinical curriculum. *Medical education online*, 14, 1.

Parsell, G. and Bligh, J., 1999. The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). *Medical Education*, (33), 95–100.

Pawson, R. and Tilley, N., 1997. *Realistic evaluation*. Sage.

Pell, G., Fuller, R., Homer, M., and Roberts, T., 2010. How to measure the quality of the OSCE: A review of metrics AMEE guide no. 49. *Medical Teacher*, 32 (10), 802–811.

Pelloux, S., Grégoire, A., Kirmizigul, P., Maillot, S., Bui-Xuan, B., Llorca, G., Boet, S., Lehot, J.-J.J., and Rimmelé, T., 2017. Peripheral venous catheter insertion simulation training: A randomized controlled trial comparing performance after instructor-led teaching versus peer-assisted learning. *Anaesthesia Critical Care & Pain Medicine*, 36 (6), 397–402.

Perry, M.E., Burke, J.M., Friel, L., and Field, M., 2010. Can training in musculoskeletal examination skills be effectively delivered by undergraduate students as part of the standard curriculum? *Rheumatology*.

Pluta, W.J., Richards, B.F., and Mutnick, A., 2013. PBL and Beyond: Trends in Collaborative Learning. *Teaching and Learning in Medicine*, 25 (1, SI), S9–S16.

Pocock, S.J., 1999. Chapter 8 - Crossover Trials. *In*: *Clinical Trials - A*

Practical Approach. John Wiley & Sons, Ltd, 110–122.

Poulton, T., Ellaway, R.H., Round, J., Jivram, T., Kavia, S., and Hilton, S., 2014. Exploring the efficacy of replacing linear paper-based patient cases in problem-based learning with dynamic web-based virtual patients: Randomized controlled trial. *Journal of Medical Internet Research*, 16 (11), e240.

Prideaux, D., 2003. ABC of learning and teaching in medicine. Curriculum design. *BMJ (Clinical research ed.)*, 326 (7383), 268–70.

R Core Team, 2018. *R: A Language and Environment for Statistical Computing*. Vienna Austria: R Foundation for Statistical Computing.

Radcliffe, C. and Lester, H., 2003. Perceived stress during undergraduate medical training: a qualitative study. *Medical Education*, 37 (1), 32–38.

Räder, S.B.E.W., Henriksen, A.-H., Butrymovich, V., Sander, M., Jørgensen, E., Lönn, L., and Ringsted, C. V., 2014. A Study of the Effect of Dyad Practice Versus That of Individual Practice on Simulation-Based Complex Skills Learning and of Students' Perceptions of How and Why Dyad Practice Contributes to Learning: *Academic Medicine*, 89 (9), 1287–1294.

Rashid, H., Lebeau, R., Saks, N., Cianciolo, A.T., Artino, A.R., Shea, J.A., and ten Cate, O., 2016. Exploring the Role of Peer Advice in Self-Regulated Learning: Metacognitive, Social, and Environmental Factors. *Teaching and Learning in Medicine*, 28 (4), 353–357.

Rees, C.E. and Monrouxe, L. V, 2011. "A Morning Since Eight of Just Pure Grill": A Multischool Qualitative Study of Student Abuse. *Academic Medicine*, 86 (11), 1374–1382.

Rees, D.C.E., Bradley, P., Collett, T., and McLachlan, J.C., 2005. "Over my dead body?": the influence of demographics on students' willingness to participate in peer physical examination. *Medical Teacher*, 27 (7), 599–605.

Rees, E.L., Quinn, P.J., Davies, B., and Fotheringham, V., 2016. How does peer teaching compare to faculty teaching? A systematic review and meta-analysis. *Medical Teacher*, 38 (8), 829–837.

Riese, H., Samara, A., and Lillejord, S., 2012. Peer relations in peer learning. *International Journal of Qualitative Studies in Education*, 25 (5), 601–624.

Roff, S., McAleer, S., Harden, R.M., Al-Qahtani, M., Ahmed, A.U., Deza, H., Groenen, G., and Primparyon, P., 1997. Development and validation of the Dundee Ready Education Environment Measure (DREEM). *Medical Teacher*, 19 (4), 295–299.

Ronson, S. and Peterson, R.S., 2008. The paradox of conflict in groups: Conflict with trust is the basis for deep-level cooperation in work groups. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction.* Oxford, UK: Blackwell Publishing Ltd, 181–197.

Ryan, A., McColl, G.J., O'Brien, R., Chiavaroli, N., Judd, T., Finch, S., and Swanson, D., 2017. Tensions in post-examination feedback: information for learning versus potential for harm. *Medical Education*, 51 (9), 963–973.

Salas, E., DiazGranados, D., Weaver, S.J., and King, H., 2008. Does team training work? Principles for health care. *Academic Emergency Medicine*, 15 (11), 1002–1009.

Schuwirth, L.W. and Van der Vleuten, C.P., 2013. How to Design a Useful Test: The Principles of Assessment. *In*: *Understanding Medical Education: Evidence, Theory and Practice: Second Edition*. 241–254.

Scott, H., 2009. Data Analysis: Getting conceptual. *The Grounded Theory Review*, 8 (2), 89–109.

Secomb, J., 2008. A systematic review of peer teaching and learning in clinical education. *Journal of Clinical Nursing*, 17 (6), 703–716.

Sennett, R., 2012. Introduction - Online Cooperation. New Haven, Conn: Yale University Press ; London, 24–28.

Sevenhuysen, S., Skinner, E.H., Farlie, M.K., Raitman, L., Nickson, W., Keating, J.L., Maloney, S., Molloy, E., and Haines, T.P., 2014. Educators and students prefer traditional clinical education to a peer-assisted learning model, despite similar student performance outcomes: a randomised trial. *Journal of Physiotherapy*, 60 (4), 209–216.

Sevenhuysen, S., Thorpe, J., Barker, L.A., Keating, J.L., Molloy, E.K., Haines, T., and Sevenhuysen, S., 2017. Education in peer learning for allied health clinical educators: A mixed methods study. *Focus on Health Professional Education*, 18 (2), 4–18.

St-Onge, C., Martineau, B., Harvey, A., Bergeron, L., Mamede, S., and Rikers, R., 2013. From See One Do One, to See a Good One Do a Better One: Learning Physical Examination Skills Through Peer Observation. *Teaching and Learning in Medicine*, 25 (3), 195–200.

Stegmann, K. 2, Pilz, F. 3, Siebeck, M., and Fischer, F., 2012. Vicarious learning during simulations: is it more effective than hands-on training? *Medical Education*, 46 (10), 1001–1008.

Storrar, N., Hope, D., and Cameron, H., 2019. Student perspective on outcomes and process–Recommendations for implementing

competency-based medical education. *Medical Teacher*, 41 (2), 161–166.

Sullivan, B.A., Snyder, M., and Sullivan, J.L., 2008a. *Cooperation: The political psychology of effective human interaction.* Cooperation: The political psychology of effective human interaction. Oxford, UK: Blackwell Publishing Ltd.

Sullivan, B.A., Snyder, M., and Sullivan, J.L., 2008b. The centrality of cooperation in the functioning of individuals and groups. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction.* Oxford, UK: Blackwell Publishing Ltd, 1–16.

Sullivan, B.A., Snyder, M., Sullivan, J.L., and Chapp, C., 2008. The political psychology of cooperation: Synthesis and prospects. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction.* Oxford, UK: Blackwell Publishing Ltd, 343–358.

Tai, J., Molloy, E., Haines, T., and Canny, B., 2016. Same-level peer-assisted learning in medical clinical placements: A narrative systematic review. *Medical Education*, 50 (4), 469–484.

Tai, J.H.-M., Haines, T.P., Canny, B.J., and Molloy, E.K., 2014. A Study of Medical Students' Peer Learning on Clinical Placements: What They Have Taught Themselves to Do. *Journal of Peer Learning*, 7, 57–80.

Tai, J.H., Canny, B.J., Haines, T.P., and Molloy, E.K., 2016a. Identifying Opportunities for Peer Learning: An Observational Study of Medical Students on Clinical Placements. *Teaching and Learning in Medicine*, 29 (1), 1–12.

Tai, J.H.M., Canny, B.J., Haines, T.P., and Molloy, E.K., 2016b. The role of peer-assisted learning in building evaluative judgement: opportunities in clinical medical education. *Advances in Health Sciences Education*, 21 (3), 659–676.

Tai, J.H.M., Canny, B.J., Haines, T.P., and Molloy, E.K., 2017. Implementing Peer Learning in Clinical Education: A Framework to Address Challenges In the "Real World". *Teaching and Learning in Medicine*, 29 (2), 162–172.

Tallentire, V.R., Smith, S.E., Skinner, J., and Cameron, H.S., 2012. The preparedness of UK graduates in acute care: a systematic literature review. *Postgraduate Medical Journal*, 88 (1041), 365–371.

Tallentire, V.R., Smith, S.E., Wylde, K., and Cameron, H.S., 2011. Are medical graduates ready to face the challenges of Foundation training?

Postgraduate Medical Journal, 87 (1031), 590–595.

Tashakkori, A. and Teddlie, C., 1998. *Mixed methodology : combining qualitative and quantitative approaches*. Thousand Oaks California: Sage.

Thulesius, H., Håkansson, A., and Petersson, K., 2003. Balancing: A Basic Process in End-of-Life Cancer Care. *Qualitative Health Research*, 13 (10), 1353–1377.

Tolsgaard, M.G., Bjørck, S., Rasmussen, M.B., Gustafsson, A., and Ringsted, C., 2013. Improving Efficiency of Clinical Skills Training: A Randomized Trial. *Journal of General Internal Medicine*, 28 (8), 1072–1077.

Tolsgaard, M.G., Kulasegaram, K.M., and Ringsted, C., 2017. Practical trials in medical education: linking theory, practice and decision making. *Medical Education*, 51 (1), 22–30.

Tolsgaard, M.G., Kulasegaram, K.M., and Ringsted, C. V, 2016. Collaborative learning of clinical skills in health professions education: the why, how, when and for whom. *Medical Education*, 50 (1), 69–78.

Tolsgaard, M.G., Madsen, M.E., Ringsted, C., Oxlund, B.S., Oldenburg, A., Sorensen, J.L., Ottesen, B., and Tabor, A., 2015. The effect of dyad versus individual simulation-based ultrasound training on skills transfer. *Medical Education*, 49 (3), 286–295.

Tolsgaard, M.G., Rasmussen, M.B., Bjørck, S., Gustafsson, A., Ringsted, C. V, Tolsgaard, M.G., Rasmussen, M.B., Bjørck, S., Gustafsson, A., and Ringsted, C. V, 2014. Medical students' perception of dyad practice. *Perspect Med Educ*, 3, 500–507.

Tolsgaard, M.G., Tabor, A., Madsen, M.E., Wulff, C.B., Dyre, L., Ringsted, C., and Nørgaard, L.N., 2015. Linking quality of care and training costs: Cost-effectiveness in health professions education. *Medical Education*, 49 (12), 1263–1271.

Topping, K.J., 1996. The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education*, 32 (3), 321–345.

Topping, K.J., 2009. Peer Assessment. *Theory Into Practice*, 48 (1), 20–27.

Tracy, S.J., 2010. Qualitative Quality: Eight "Big-Tent" Criteria for Excellent Qualitative Research. *Qualitative Inquiry*, 16 (10), 837–851.

Tyler, T.R., 2008. The psychology of cooperation. *In*: B.A. Sullivan, M. Snyder, and J.L. Sullivan, eds. *Cooperation: The political psychology of effective human interaction.* Oxford, UK: Blackwell Publishing Ltd, 105–

121.

Varpio, L., Ajjawi, R., Monrouxe, L. V, O'Brien, B.C., and Rees, C.E., 2017. Shedding the cobra effect: Problematising thematic emergence, triangulation, saturation and member checking. *Medical Education*, 51 (1), 40–50.

Visser, K., Prince, K.J., Scherpbier, A.J., van der Vleuten, C.P.M., and Verwijnen, G.M., 1998. Student participation in educational management and organization. *Medical Teacher*, 20 (5), 451–454.

Vygotsky, L.S., 1978. *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Walsh, I., 2014. A strategic path to study IT use through users' IT culture and IT needs: A mixed-method grounded theory. *Journal of Strategic Information Systems*, 23 (2), 146–173.

Walsh, I., Holton, J.A., Bailyn, L., Fernandez, W., Levina, N., and Glaser, B., 2015a. What Grounded Theory Is…A Critically Reflective Conversation Among Scholars. *Organizational Research Methods*.

Walsh, I., Holton, J.A., Bailyn, L., Fernandez, W., Levina, N., and Glaser, B., 2015b. Rejoinder. *Organizational Research Methods*, 18 (4), 620–628.

Walton, H.J. and Matthews, M.B., 1989. *Essentials of problem-based learning*. Medical Education.

Wang, Y. and Chen, H.-J., 2012. Use of Percentiles and Z-Scores in Anthropometry. *In*: *Handbook of Anthropometry*. New York, NY: Springer New York, 29–48.

Watling, C., 2015. When I say … learning culture. *Medical Education*, 49 (6), 556–557.

Watling, C., Driessen, E., van der Vleuten, C.P.M., and Lingard, L., 2012. Learning from clinical work: the roles of learning cues and credibility judgements. *Medical Education*, 46 (2), 192–200.

Watling, C., Driessen, E., van der Vleuten, C.P.M., Vanstone, M., and Lingard, L., 2013a. Beyond individualism: professional culture and its influence on feedback. *Medical Education*, 47 (6), 585–594.

Watling, C., Driessen, E., van der Vleuten, C.P.M., Vanstone, M., and Lingard, L., 2013b. Music lessons: revealing medicine's learning culture through a comparison with that of music. *Medical Education*, 47 (8), 842–850.

Watling, C., LaDonna, K.A., Lingard, L., Voyer, S., and Hatala, R., 2016. "Sometimes the work just needs to be done'': socio-cultural influences

on direct observation in medicaltraining". *Medical Education*, 50 (10), 1054–1064.

Watling, C.J. and Lingard, L., 2012. Grounded theory in medical education research: AMEE Guide No. 70. *Medical Teacher*, 34 (10), 850–861.

Weaver, S.J., Rosen, M.A., Salas, E., Baum, K.D., and King, H.B., 2010. Integrating the science of team training: guidelines for continuing education. *The Journal Of Continuing Education In The Health Professions*, 30 (4), 208–220.

www.SciJournal.org, 2019. Medical teacher. [online]. Available from: https://www.scijournal.org/impact-factor-of-MED-TEACH.shtml [Accessed 27 Apr 2019].

Yamagata-Lynch, L.C., 2010. *Activity Systems Analysis Methods*. Boston, MA: Springer US.

Young, I., Montgomery, K., Kearns, P., Hayward, S., and Mellanby, E., 2014. The benefits of a peer-assisted mock OSCE. *The Clinical Teacher*, 11 (3), 214–218.

Young, J.E., Williamson, M.I., and Egan, T.G., 2016. Students' reflections on the relationships between safe learning environments, learning challenge and positive experiences of learning in a simulated GP clinic. *Advances in Health Sciences Education*, 21, 63–77.

Zaidi, Z., Jaffery, T., Shahid, A., Moin, S., Gilani, A., and Burdick, W., 2011. Change in action: using positive deviance to improve student clinical performance. *Advances in Health Sciences Education*, 17 (1), 95–105.

van der Zwet, J., Zwietering, P.J., Teunissen, P.W., van der Vleuten, C.P.M., Scherpbier, A.J.J.A., Zwet, J. van der, Zwietering, P.J., Teunissen, P.W., Vleuten, C.P.M. van der, and Scherpbier, A.J.J.A., 2011. Workplace learning from a socio-cultural perspective: creating developmental space during the general practice clerkship. *Advances in Health Sciences Education*, 16 (3), 359–373.